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EDITORIAL

To Freeze or Not to Freeze

PERUSAL of the article by J. P. Schaenzer, in the pages following, impresses us anew with the value of personal attendance at A.S.A.E. technical meetings, now curtailed by war considerations. Comprehensive and well-balanced as is this article, it is bereft of the discussion which followed and which went far to clarify and amplify certain of the unsettled points. Nor would any attempt to report and epitomize such discussion reflect accurately the varying degrees of emphasis, conviction, and background represented.

For precisely that reason it is with diffidence that we now mention an impression gained from the discussion of this paper. Outstanding exceptions are indicated, but it would appear that the majority of farmers will, eventually if not immediately, prefer to use their farm freezers primarily for storage. They will also use them for initial freezing of small amounts of fruits, vegetables and perhaps of poultry. For larger lots, such as a butchering of beef or pork, or the main maturity of fruit and vegetable crops, they will prefer to utilize the service of a locker plant.

Such preference is not based on the engineering of refrigeration, but on the skill, man-hours, supplies and facilities used in preliminary processing and packing prior to freezing. For this work the locker plant has the experts and the equipment. It also has capacity for freezing at optimum rates. It can repeat the freezing operation for a host of farmers, whereas the farmer's own equipment, if large enough, would have a freezing load only a few days per year, inefficient both as to investment and energy demand.

Technically, all this is but a detail in the broad realm of agriculture and its engineering. We deem it important as an example of increasing interdependence between the farm and rural industry. The practice of dividing and sharing functions according to the load on farm man power, availability of skills, and efficiency in use of equipment is full of promise. It is in line with the vision of rural industry portrayed in the presidential address by Professor R. H. Driftmier published last month in these pages.

Before agriculture goes too far in becoming dependent on rural industry, however, consideration should be given to an increasing hazard. That is the possibility of sabotage and spoilage arising from suspensions of service by conspiracy or stampede among the industrial employes. Theoretically, such social and political phenomena are no part of agricultural engineering subject matter; actually, they may prove a potent deterrent to one of its happier developments.

Again That Ceiling

IN HIS letter published in these pages last month (page 294) W. A. Harper confirms and amplifies the point discussed in our editorial "Red Schoolhouse Ceiling"; namely, the low educational level prevailing among farmers. He treats it as we all have had to consider it in the past, and in some degree must continue to consider it; that is, a fixed condition with which we must contend as best we can.

He points out that making instructions comprehensible to them is the "most difficult of all editorial work." We challenge the whole assumption that such scant literacy is necessary, or can long be tolerable. It implies a tacit assent that farming is and should continue a low order of occupation. We insist that as a job of management farming demands at least as good an educational background as any other managerial job involving a comparable amount of irreplaceable resources. We insist that farm people deserve such a degree of education for its own sake.

It is all very well to glorify simplicity, but there comes a point beyond which it is grossly inefficient, if not actually impossible, to present twelfth-grade subject matter in fourth-grade language. We join Mr. Harper in his tribute to the wide practical knowledge, and we would add the innate intelligence, of the typical farmer. Observation at both the secondary and college levels indicates that farm-reared students generally are above average in educational response. Their talent deserves, and their occupation demands, the implementation of basic sciences, a bit of mathematics and economics, perhaps the perspective of history, and certainly facile reading in English.

As agricultural engineers we can do only a part of the job, but it can be the pioneer part. All educators and all farm leaders may well join in a long-range campaign which will not be done until at least a high-school diploma is *sine qua non* for the operating farmer.

Sell Surpluses Soundly

AS THE disposal of surplus military supplies gets under way we are moved once more to make a plea for such methods of distribution as will serve agriculture well with its logical share of them. In usage most of such supplies will fall within the domain of agricultural engineering.

To a far greater extent than is true of urban industry, surplus goods going to agriculture should go through regular peacetime channels. Few farmers can take the time or travel the distance to inspect and select material at government concentration points, even if they were qualified to judge the suitability and value of the wares. Neither is it in the best interest of either the farmer or the general economic structure for him to find such surplus goods offered only or mainly by the fire-sale type of speculative distributor.

When he secures a salvaged truck, tractor, or centrifugal pump he should buy it with the backing of a responsible company, one which has the facilities and the character to put it into thoroughly sound condition and price it equitably; furthermore, to follow through with shop and repair service throughout its useful life. We believe the government should make every reasonable effort to guide mechanical and electrical equipment into responsible channels regularly dealing with farmers and maintaining permanent service.

Likewise building materials, new or salvaged, should reach him through one of his own local lumber dealers, someone permanently interested in his goodwill as a customer, and able to advise him as to the value of any item for a proposed purpose. Local dealers, in turn, should not have to go all the way to the government, but rather be able to secure surplus supplies blended in with shipments from their regular sources, and with the same responsibility for quality and fair pricing.

Desirability of getting goods into regular channels at the highest feasible level goes deeper than dependable quality and sustained service on a specific purchase by the farmer. In all his operations he leans largely on prompt, competent local dealers. It is in the general interest that they enjoy steady, reasonably profitable busi- *(Continued on page 332)*

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Engineering Farm Refrigeration

By J. P. Schaenzer
FELLOW A.S.A.E.

BEFORE farm refrigerators for all purposes can be designed it is necessary to establish functional and physical specifications, and then testing and rating procedures. All of these involve basic fundamentals, important to the manufacturer if he expects to stay in business and important to the user as to satisfactory and economic operation and long life. In this connection definitions must be established and clarified.

In general, physical specifications should be left to the manufacturer, especially when so many new materials are being introduced and new devices are being developed constantly to perform certain functions of the complete job. It seems that control over these through physical specifications other than those by the individual manufacturer would curtail progress.

Farm refrigeration is being built upon a foundation of knowledge gained progressively through research and practical experience. W. D. Hemker, chairman, Rural Electric Division, American Society of Agricultural Engineers, reports the setting up of projects in three committees dealing with various phases of farm refrigeration. The Committee on Agricultural Refrigeration gives consideration to all phases, while the Committee on Farm Food Processing and the Committee on Farm Electric Equipment are chiefly concerned with home freezers. The American Society of Refrigerating Engineers has also done some excellent work in connection with establishing refrigeration standards. Definitions involving various phases of refrigeration have been made possible as the result of research by state agricultural colleges and other institutions.

Farm and Home Freezers and Refrigerators. The most talked about refrigeration equipment are the farm and home freezers. It is significant that it was necessary to set up terminology for this equipment. Because of the diversity of terms used, the National Electrical Manufacturers Association at a meeting in Chicago on April 26, 1944, officially recommended the name "home freezer" for the "household type of low-temperature, mechanically refrigerated cabinet used exclusively for the freezing and/or storage of frozen food." Many terms such as "sharp freezer," "quick freezer," and others have been used in the past to describe this equipment. The action of N.E.M.A. is intended to correct this situation.

This paper was presented at a meeting of the Chicago Section of the American Society of Agricultural Engineers at Chicago, Ill., June 5, 1945.

J. P. Schaenzer is acting head, special problems section, technical standards division, Rural Electrification Administration, U. S. Department of Agriculture.

An association, known as the Farm and Home Freezer Manufacturers Association, has been formed with headquarters at Washington, D. C., and according to E. G. Vail, executive secretary, the Association is vitally interested in the promotion of quality merchandise and in establishing standards, so that the public may be assured of a quality of manufacture which will insure successful performance. He further states that at a meeting of the Association held in Chicago on February 28, 1945, the subject of standards was discussed and a committee appointed to cooperate with the American Society of Refrigerating Engineers and the American Standards Association. It is hoped that this will result in quality merchandise for the consumer.

For some time Michigan State College has had under consideration the establishment of refrigeration testing laboratories. D. Emerson Wiant, associate professor of agricultural engineering at that institution, writes that this should be done and that efforts will continue on their part to try to do something about it. Let us hope that this will come to pass, for it certainly is a worthwhile endeavor that is needed by the industry.

When materials again become available, many different types, designs, shapes, and sizes of freezers will be produced and placed on the market. Among them will be the chest-type home freezer with lift top. Upright freezers with vertical doors will also be available. In some cases doors may be smaller than the cross-section area of the compartment. Upright units may have inner doors to prevent spilling of cold air when the outer doors are opened. Others may be equipped with drawers similar to filing cases.

Large-size, upright, two-temperature reach-in refrigerators with a portion devoted to frozen foods and the balance to household refrigeration of perhaps 35 to 40 F (degrees Fahrenheit) will also be available. The manufacturer will also supply walk-in, two-temperature units. These will be a combination cooler and freezer. The temperature of the former will be approximately 38 F and of the latter, 0 F. This will permit chilling and curing of meat before cutting, wrapping, and freezing. This type of unit can be especially effective as to economy of operation because the frozen-food storage compartment can be built so as to have its walls entirely separate from that

of the cooler with an air space around it; thus the freezer is actually operated in an ambient temperature of approximately 38 F. In addition to the various units just mentioned, household refrigerators will also have a frozen-foods compartment. This may average 2 cu ft per unit. One manufacturer claims the introduction of such a refrigerator in 1929. According to reports, it was not accepted by the public at that time because so little was known about frozen foods. Several manufacturers built and sold such equipment before the war. It has been predicted that refrigerators of the future will eventually all be of the two-temperature type. Walk-in storage coolers at 38 F will also be available. This will provide storage on farms primarily for vegetables and fruits held for a favorable marketing time. Reach-in refrigerators of many sizes, with varying numbers of doors, will also be available to the farmer. Functional requirements again come into play. A question raised on several occasions pertains to the dimensions of the 10-gal milk can and 15-doz egg case. The intention of some manufacturers has been to dimension the interior exactly so that it will accommodate either or both without waste of space. In addition, other problems require consideration.

Diverting briefly from the subject, attention is called to low-temperature cabinets designed and built during this war, having numerous commercial and industrial applications. Among them are rivet and metal shrinking, blood-plasma production, instrument testing and others. Only recently a St. Louis manufacturer completed three most interesting low-temperature cabinets to be used in the process of manufacturing penicillin. One requirement was that each cabinet have a capacity of approximately 2000 2-cc bottles to be reduced from room temperature to –70 F in less than an hour. It is reported that this equipment increased the production of the largest penicillin manufacturer from 8000 to 156,000 2-cc bottles per day. All this experience in the field of low-temperature equipment should definitely underwrite the success of the home freezer and all other farm-refrigeration equipment.

FUNCTIONAL SPECIFICATIONS HAVE BEEN PREPARED FOR REFRIGERATION EQUIPMENT

The Rural Electrification Administration has prepared functional specifications for a home freezer and storage chest of 20-cu-ft capacity. These are considered tentative in nature and subject to revision as better information is made available through research and field experience. Suggestions are always welcome. Physical specifications were purposely avoided in view of the many materials such as insulation that can be used and that may be developed. Of special interest are the requirements of the food to be frozen and stored.

Three years ago a survey was made by REA among research specialists who had studied the problems involving the freezing of foods. A report of this survey was presented at the annual meeting of the American Society of Agricultural Engineers in June, 1942, and published in AGRICULTURAL ENGINEERING for March, 1943. At that time there was much disagreement among authorities as to freezing and storage requirements of foods in order to retain the original quality. Through research and experience much of this has been eliminated. For example, on the question of the recommended rate of freezing beef, 18 replies were received. One said to freeze as quickly as possible; another, fast freezing is not practical; two said time of freezing is of little importance; and one gave no answer. To this same question other individuals gave specific time limits. These range all the way from 2 hr to 24 hr. The number considering 8 hr or less to be most desirable was equal to those favoring 8 hr or more. Notice the diversity of opinion. How can an engineer design any equipment with such contradiction? Fortunately since that time it has been generally accepted that the rate of freezing in home freezers may not be as important as several other factors affecting the quality of the final product.

We are told by authorities on the subject that none but freshly harvested vegetables should be frozen. It is most important that the time elapsed between harvesting and being placed in the freezer be the shortest possible. While it is desirable to freeze the vegetables as rapidly as possible, most of the original quality will be retained if frozen in from 12 to 18 hr. The freezing time, according to tests, can be cut in half by using a blast of air.

Dr. D. K. Tressler reports that approximately 14 hr are required to freeze a 3¾-lb beef roast in still air. Freezing can also be speeded up by placing the product on or next to freezing coils or plates. Rather small quantities should be frozen at one time.

Professor J. R. Tavernetti, of the University of California, in a paper entitled "Construction and Operation of Farm Freezers," presented at the seventeenth rural electric conference of California on February 12, 1945, said, "Quick freezing as done by commercial firms is not practical in farm freezers. Although tests have indicated that quick freezing makes a somewhat better product, it is not a necessity and a good product can be obtained by slow freezing (freezing within 24 hr)."

GENERAL AGREEMENT THAT HOME FREEZER SHOULD OPERATE AT ZERO TEMPERATURE

At the time of the REA survey, storage temperatures recommended varied from –5 to 10 F. There seems to be more general agreement today that the home freezer should be operated at zero. The turnover of frozen fruits and vegetables on the farm or in the home will approximate one year or from one season to the next. It is known that these products will keep well at zero for one year.

Now how about the keeping quality of frozen meat. Experience indicates that there is a direct relationship between the storage temperature and the period of time that the meat can be kept. According to Dr. Tressler, pork will become slightly rancid in four months at 10 F. It will be in perfect condition at zero at the end of twelve months. Research at the USDA Beltsville Research Center conducted under the supervision of Miss Lenore E. Sater of the Bureau of Human Nutrition and Home Economics, verifies this finding. A report dated March 2, 1943, reads as follows: "Pork which was frozen and stored for 12 months was recently taken out and tested and was reported as good as fresh pork with no signs of rancidity discernible to the taste. Vegetables, fruits, and meats frozen in this freezer have been taken out and tested after periods of 2 to 12 months storage and have been of excellent quality." Fowl is subject to rancidity to about the same degree as pork. Other meats keep better under comparable conditions. So, again, zero is recommended for all meat storage as it will keep for a year or more without noticeable deterioration.

Refrigeration equipment intended for uses in the home must be designed so that it will pass through a doorway. For that reason it is considered best to limit one dimension of the unit to under 30 in.

Accessibility of the stored food in the various types of refrigerators and home freezers presents another engineering problem. Indications are that no satisfactory solution has been found to this problem.

The installation of an alarm to inform the user that the equipment has ceased functioning for any reason what-

soever also requires further study. This naturally brings up the subject of outages and service. Because of the possibility of a large amount of food being involved, worth considerable money, it is definitely essential that replacement of all parts and putting the unit in operating order again be arranged for through a dealer-service organization without spoilage of the contents. That brings up another question. How long can the unit go without operating and not have food spoilage? Tests to determine the ability of freezers to maintain refrigeration temperatures after disruption of the electric supply circuit are under way by the USDA Bureau of Human Nutrition and Home Economics. These tests are conducted under full-load and one-fourth-load conditions. These result data should be available soon. It may also help to decide whether or not eutectic solutions should be used as carry-over in case of emergencies. The use of dry ice has also been suggested for such conditions. On this same subject, in a paper entitled "Home Freezers—Present and Future," presented before the annual meeting American Society of Refrigerating Engineers, on December 12, 1944, Dr. D. K. Tressler said:

> "In experimental tests, food in a well-filled 2-cu-ft cabinet did not thaw to any considerable extent until approximately 72 hr after the current was cut off. The upper layer of packages did not rise above 32 F until 96 hr had elapsed, even though the ambient temperature was 80 F. The bottom layer of packages required more than 120 hr to thaw. Similar results were obtained in a test of a 4-cu-ft home freezer.
>
> "Food held in larger cabinets (12 to 36-cu-ft capacity) would hold frozen foods for somewhat longer periods before thawing would be noted. Even in the summer it is doubtful if the food in any part of a nearly full, well-insulated, 24-cu-ft cabinet would begin to spoil in less than five days after the current is cut off."

Experience and tests will provide the answer to this problem.

REA in its functional specifications makes the following statement: "An automatic temperature control adjustable within a range of approximately –20 to +20 F shall be used to control storage temperature." This may have both advantages and disadvantages for the user. "The control shall be capable of maintaining the temperature of the storage compartment within two degrees plus or minus of the temperature at which it is set except when freezing is being done." If this is correct from an operating standard, it is not difficult to provide the electric controls. The installation of a switch so that the freezer can be operated continuously to reduce the temperature of the unit prior to freezing foods may also have merit. Without a doubt there are others.

QUANTITY OF FOOD THAT CAN BE FROZEN AT ONE TIME IS LIMITED

The quantity of foods that can be frozen in a home freezer at one time is usually limited to a rather small amount. Professor Tavernetti, in his paper on February 12, 1945, stated, "The amount of products frozen in the home freezer per 24 hr should not exceed about 5 per cent of the capacity of the box." The BHNHE reports the satisfactory freezing of meats in quantities of about 50 lb with single roasts weighing as much as 11 lb as a part of the load placed in a 20-cu-ft home freezer. They also conducted water-freezing tests with the storage compartment fully loaded and found in a typical case that the maximum time for solidification with forced-air circulation was 12 hr for a 100-lb load. It took 25 hr to bring all of the water to zero. For 50 lb of water the time for solidification was 8 hr, and the time required to bring the water to zero from 14 to 15 hr. With forced circulation of the air the maximum solidification time for the water was approximately one-half as compared with that of still air. However, with the fan operating, the energy consumption increased slightly per pound of water frozen.

This type of research may be helpful in setting up testing standards and rating procedures. Energy consumption under specific conditions may serve as another criterion. Testing and rating procedures should be developed, universally accepted and employed by the industry.

Milk Cooler. Let us give consideration to the farm milk cooler. There again we have available different types —among them the immersion and dry-storage units and the aerator or surface cooler. The combination surface cooler and dry-storage cabinet lends itself to the producer of bottled milk while the wet-storage unit is especially adapted to the dairyman selling bulk milk. This equipment has been well engineered and adapted to milk-cooling requirements. Complete units ready to be connected to an electric circuit are available. Much has also been written and plans prepared on building the insulated tank on the farm. For these, complete drop-in cooler units or an assembly of coils and condensing unit can be secured and installed. Several types of agitators to circulate the water among the cans hasten the cooling of the milk.

It is gratifying to be able to state that the American Society of Refrigerating Engineers on December 2, 1942, adopted standard methods of rating and testing complete can-type milk coolers. But now that we have these standards, and assuming that they are a job well done—for the best brains in the field of milk refrigeration are responsible for them—how and by whom are they to be applied? I ask you. Certainly they will not do much good lying on the shelves of the society. What action can be taken to put them in force to protect both the manufacturer of reliable milk coolers and the user as well? This also holds good for other electrical merchandise, as soon as testing and rating procedures can be established.

THE EGG COOLER HAS DEMONSTRATED THAT IT PAYS

Egg Cooler. Cooling of eggs on the farm is another problem. And, it pays. In 1942, Albert Arnold of Howard, Ohio, stated that he had a laying flock of 4,000 hens. He installed a six-basket evaporator-type egg cooler and estimated that he secured a $3\frac{1}{2}$ cent increase per dozen eggs because of cooling them. Formerly all were graded as "standards." Now he is selling them as "extras" and even a few "specials."

Cornell University as a part of its egg-marketing program recommends that the egg room be kept well ventilated, but without cross drafts, and at a temperature between 35 and 55 F. Also, the egg room should be kept fairly moist, 70 per cent humidity or higher.

An excellent paper, entitled "The Application of Mechanical Refrigeration to Ranch Egg Cooling," was presented by Dr. F. W. Lorenz on February 12, 1945, at the California Rural Electric Conference. In part he states: "A cabinet type of egg cooler was selected for study. The temperature chosen was 55 F. This is considerably higher than the optimum (although it is optimum for hatching eggs) but is, for several reasons, a more reasonable temperature for farm egg storage than lower temperatures would be. When eggs are to be held for a few days only, the additional expense of cooling to cold-storage temperature would probably not be economical; furthermore, if the eggs are cooled to below the dew point of the outside air they will sweat when removed for shipment. Also, 55 F can be maintained readily by a relatively small unit without frosting the coils, and this feature is highly desirable from the standpoint of maintaining a reasonable humidity and of operational convenience. A $\frac{1}{4}$-hp com-

pressor unit with a small, 12x13-in two-row evaporator coil will maintain the desired conditions if it is operated with a 200-cfm air flow past the coil." He further states that the cabinet was designed to be used with a 2000-hen flock and has space to cool four baskets at a time and storage space for 11 cases.

These egg-cooling cases are presented merely to indicate the requirements of the poultryman and serve as a guide to the engineers in designing the equipment. Again, no functional specifications as such have been prepared. Nor have testing and rating guides been set up for egg-cooling equipment. These are jobs still to be done.

Home Air Conditioning. Engineers must also give consideration to the requirements of air conditioning farm homes. Certainly requests for such equipment will come from farmers the same as city people. In this connection attention must also be given to the so-called heat pump which will not only cool the house in the summer but also heat it in the winter. Then, how about coolers for individual rooms—both permanently installed and portable? Because of the mobility of the latter, a cooler could perhaps be used in the kitchen during the day and in the bedroom during the night. Again, all of us as engineers must work toward producing quality equipment. Consumer acceptance resulting in quantity production will bring down the price of all of these items and thus bring it within the means of more and more prospects. Recently someone estimated that, with the right price and right unit-room cooler, sales may well be one million per year.

As you probably know, experimental work has been carried on in cooling poultry houses. Consideration has been given to air conditioning dairy barns. Whether the necessary equipment has ever been installed is not known. It is known, however, that if satisfactory results are to be obtained definite and specific conditions, pertaining to the health and production of the animals, must be maintained.

In conclusion, as stated at the beginning, farm refrigeration is a vast subject. Papers could be and have been written on all phases of it. Time did not permit to consider many details in this paper. On most applications much research is still necessary to determine the requirements. When these are known, the engineers can build the equipment to meet the needs. And to repeat once more, applied testing and rating procedures are essential to protect the reputable manufacturer and ultimate user. And, lastly, do not forget that dealer service must be set up to keep the equipment in service when it is needed.

The Portable Grain Elevator-Conveyor

By J. D. Rankin

THE portable grain elevator-conveyor that has been receiving so much attention in Michigan since the late fall of 1939, is a labor-saving device that should receive the acclaim of farmers in every state of the Union where the handling of grain is a problem on the farm.

Made almost entirely of No. 2 lumber in white pine, fir, or even cedar, the elevator-conveyor is constructed similar to a trough, that is, two sideboards 8 in or more wide placed vertically and attached to a horizontal flight board. This equipment is made in lengths of 6 to 24 ft, depending on the elevating angle and distance from dump box to the storage bin. Flat-surface wooden pulleys are set at the boot or lower end and at the head or grain discharge end of the conveyor. Traveling in a clock-wise direction, the conveyor belting, of one or two-ply webbing with wooden cleats attached, rides the flight board and is supported and driven by the flat-surface wooden pulleys. Owing to the slack of the webbing on the lower pulley, it is necessary to drive the conveyor from the top or head end pulley. A piece of good radiator hose or light belting, sometimes called lagging, is placed on the upper flat pulley to produce a good grip on the conveyor webbing. Fractional horsepower electric motors are employed as power for the elevating job. The agricultural engineering department of the Michigan State College, deserves the credit for introducing the original design of the portable elevator-conveyor. At the present time some five or six similar types of elevators are in use in Michigan.

There are 140,000 electrified farms in Michigan that produce some grain, beans, and ear corn. Most of these farms can use an elevator very profitably. At harvest time, considerable labor is needed to carry grain and beans from thresher or wagon to storage bin. To remove this produce from the storage bin for delivery to the mill, or for feeding on the farm, creates a backbreaking job that is unnecessary and a waste of time. The portable elevator-conveyor will take over this job and place the grain wherever it is needed in much less time and at a small fraction of the cost of man labor.

Elevating capacities of the 4-in width conveyor we have designed range from 200 to over 400 bu of grain per hour. The capacity range is due to the difference in weight and bulkiness of various grains as well as the elevating angle, the conveyor length, and available motor capacity. Although an elevator requires a motor of a definite size for maximum elevating capacity, a smaller motor may be used for less than maximum elevating capacity by reducing the amount of grain fed to the belt. It is interesting to note that many farmers who have purchased 1/6 or 1/4-hp motors for operating tool grinders, churns, pump jacks, and other equipment are making good use of these portable motors by using them on their elevator-conveyors.

The purchase price of individual elevator parts or ready-made equipment is small in comparison with the saving made when using the conveyor. To purchase individual parts for home construction, we find a cost of $1.00 per lineal foot a good estimate. Ready-made equipment complete with drive belt of the V type is available for farms in eastern Michigan for $1.85 per lineal foot. These cost figures do not include the motor. In comparing the two costs it is not difficult to understand why the ratio of five ready-made elevators to one homemade elevator exists in our territory.

The cost of operating a portable elevator-conveyor may be compared with the cost of entertainment or food. For instance, 1000 bu of oats may be elevated for the cost of a five-cent candy bar or what used to be a nickel cigar, based on a rate of 2½c per kw-hr.

During the present war the most outstanding advantage to the farmer is the saving in man-hours. I refer directly to the capacity of the elevator-conveyor. How many men would be required to equal the elevating capacity of this equipment? I am sure the num- *(Continued on page 330)*

This paper was presented at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1943, as a contribution of the Rural Electric Division.

J. D. RANKIN is a farm service advisor for the Detroit Edison Company.

Determination of Band Stresses and Lateral Wheat Pressures for a Cylindrical Grain Bin

By L. R. Amundson

SEVERAL experimental grain bins which had been under observation at the U. S. Department of Agriculture's bin site at Jamestown, North Dakota, were emptied during the spring of 1944. One of these was a 2250-bu-capacity bin, sold under the trade name of Thermo-Seal, emptied on May 3 and 4, 1944.

This was a circular bin formed with 15 panels, each 4 ft by 10 ft, held in place with 7 steel bands. The wall height was 10 ft and the radius 9 ft 6½ in. Details of the panels and of the bin construction are shown on Figs. 1 and 2.

This bin (No. X-4 on the bin site) had been used by Dr. Paul Andersen of the University of Minnesota in August, 1942, to determine the band stresses for the purpose of checking the design of the bands and band connections.

The opportunity provided by emptying the bin in 1944 was used to redetermine the band stresses. This second examination was made with the thought that data could be developed regarding any change that may have occurred in the wheat pressure during the storage period as well as regarding the factors used in calculating design wheat pressures in Insulite bins.

Test Procedure. For the first investigation a series of 10-in gage positions had been established. Fig 3 shows on an elevation of the bin the numbering and spacing of the bands, also on a plan of the bin the numbering and circular spacing of the gages. Band Nos. 2, 4, and 7 had six gages each (Nos. 1, 1A, 2, 2A, 3, 3A) and the other bands three gages each (Nos. 1, 2, and 3. This made a total of thirty gages.

This paper was prepared expressly for AGRICULTURAL ENGINEERING. The tests reported were sponsored by the Minnesota and Ontario Paper Company.

L. R. AMUNDSON is architectural engineer, Insulite Division, Minnesota and Ontario Paper Company.

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Readings were taken with a Whittemore strain gage with a dial that was read to 100,000th of an inch. The difference in the readings divided by 100,000 gave the change in gage length in inches. Dividing this in turn by 10 (gage length) gave the change in band length in inches per inch. This unit deformation multiplied by the modulus of elasticity of the steel determined the unit stress in the steel band in pounds per square inch.

A set of readings was first taken with the bin full of wheat, a height of 9 ft 8 in. The bin was then emptied and readings were taken for heights of wheat of 8 ft 3 in and 6 ft 6 in as well as for the empty condition. For the two intermediate heights, the wheat was leveled off.

An additional set of readings was taken at gage 1A on bands 2, 4 and 7 immediately before and immediately after the grain door was opened to commence emptying the wheat. This grain door was located at the floor level nearly opposite the location of gage 1A.

Test Results. The strain gage readings are given in Table 1. The differences in readings for each gage for the various heights of grain are also shown as well as the average difference for each band at each loading.

It will be noted that individual gage readings for a particular band vary measurably in some cases from the average. An analysis of these variations tends to show that they are the result of actual variations in tension from point to point in the same band. This does not mean necessarily that the wheat pressure varied circumferentially. Rather it is very likely that there was some movement of the bands due to temperature differences caused in turn by the varying effect of the direct sun's rays. Part of the variations in gage readings may have been due to errors in reading the strain gage, but it is believed that such errors were minor.

The average gage differences have also been tabulated in Table 2. The modulus of elasticity of the steel was previously deter-

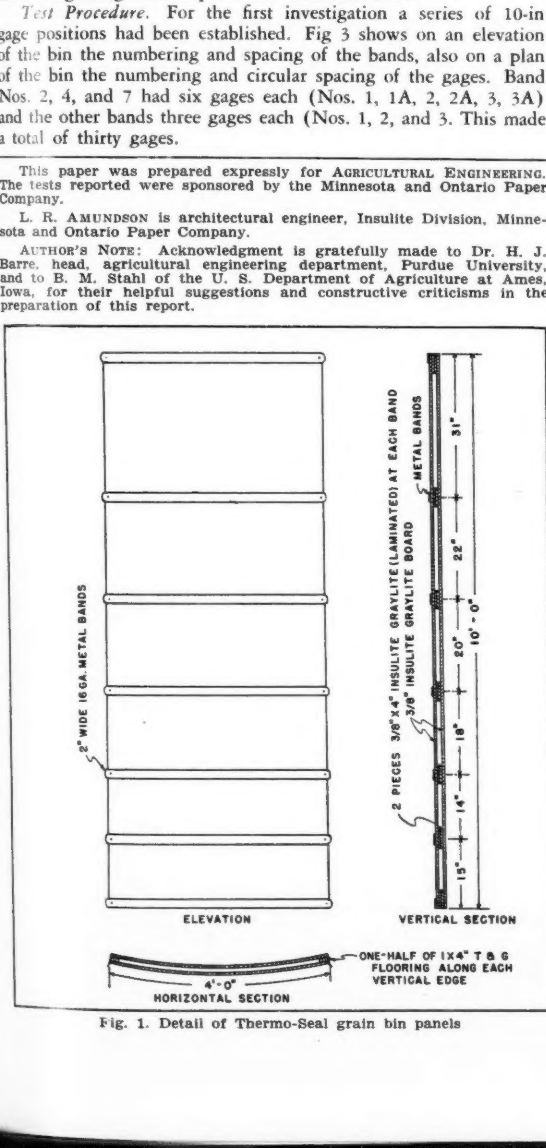


Fig. 1. Detail of Thermo-Seal grain bin panels

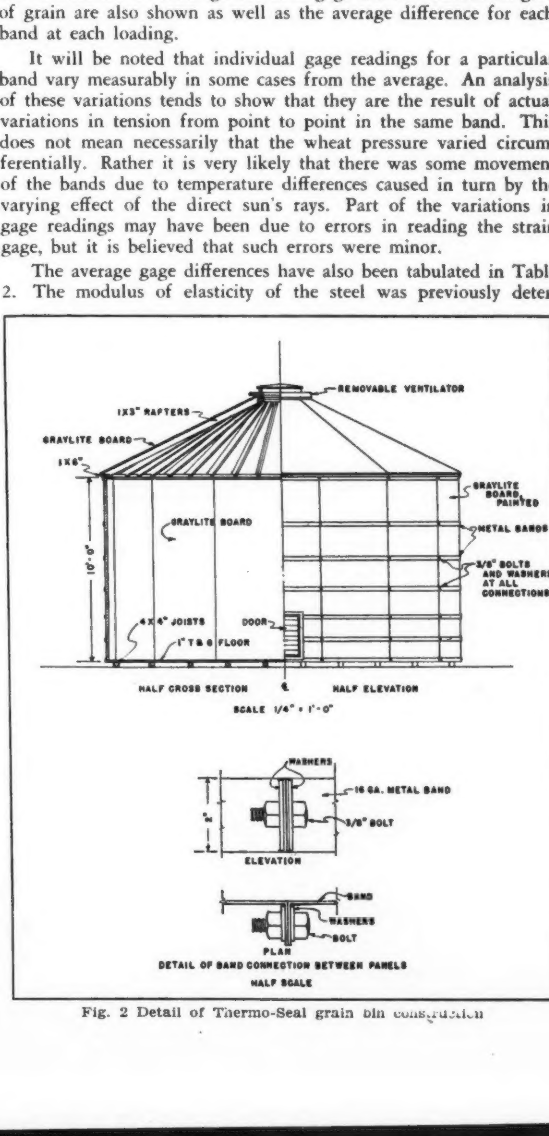


Fig. 2 Detail of Thermo-Seal grain bin construction

TABLE 1. STRAIN GAGE READINGS

			Height of Wheat					
		Empty	6 ft 6 in		8 ft 3 in		9 ft 8 in	
Band	Gage	Reading	Reading	Diff.	Reading	Diff.	Reading	Diff
	1	2590	2700	110	2675	85	2773	183
1	2	4080	4115	35	4130	50	4190	110
	3	3340	3400	60	3420	80	3445	105
	Average difference			68		72		133
	1	4470	4835	365	4835	365	4975	505
	1A	5170	5550	380	5580	410	5665	495
2	2	2290	2575	285	2620	330	2735	445
	2A	3963	4115	152	4140	177	4288	325
	3	2215	2480	265	2535	320	2645	430
	3A	7045	7385	340	7450	405	7575	530
	Average difference			298		335		455
	1	4005	4340	335	4375	370	4520	515
3	2	4570	4750	180	4835	265	4975	405
	3	4205	4505	300	4550	345	4723	518
	Average difference			272		327		479
	1	5550	5840	290	5875	325	6040	490
	1A	6460	6750	290	6823	363	6970	510
4	2	5200	5385	185	5480	280	5620	420
	2A	3348	3415	67	3515	167	3685	337
	3	3160	3375	215	3445	285	3625	465
	3A	2890	3125	235	3213	323	3335	445
	Average difference			214		291		445
	1	4475	4650	175	4720	245	4890	415
5	2	7400	7415	15	7575	175	7735	335
	3	2588	2625	37	2795	207	2980	392
	Average difference			76		209		381
	1	3852			3985	133	4155	303
6	2	5600			5610	10	5796	196
	3	4545			4610	65	4888	343
	Average difference					69		281
	1	1325					1480	155
	1A	5130					5305	175
7	2	3990					4045	55
	2A	4215					4275	60
	3	3265					3355	90
	3A	3885					4005	120
	Average difference							109

mined by Dr. Andersen and found to be 29×10^6 psi (pounds per square inch). Therefore, the gage difference divided by 10^6 and multiplied by 29×10^6 determined the unit stress in psi for the bands. The bands have a cross sectional area of 0.125 sq in. The band tensions, in pounds, were then obtained by multiplying the unit stresses by this area. The unit band stresses and the band tensions are also shown in Table 2.

The tension in each of the several bands is shown plotted against the height of wheat in the bin in Fig. 4.

The band tensions for the full bin were used to compute values for the lateral grain pressure. Use of the relationship $T = R \times P$ was made, where T = band tension, R = radius of bin, and P = radial pressure. The steps in this analysis are shown on Fig. 5. To the left of the heavy vertical line that represents the bin wall, the band tensions have been tabulated. To the right of the bin wall there is shown an approximate loading diagram for each of the areas that transmits a load to a band.

The load between band Nos. 6 and 7, treated as a uniformly increasing load, by calculation can be shown distributed with the upper 15 in transmitted to band No. 7 and the lower 12 in to band No. 6. The loading between each adjacent pair of the remainder of the bands, the diagram for which is in the form of a trapezoid, can be divided at midspan with close approximation.

The foregoing approximation assumes no continuous beam action by the wall panels of the bin. This is reasoned to be substantially correct as the only structural members at right angles to the bands were the wood strips, nominally 1 x 2 in, along each vertical edge of each panel. The ⅜-in Graylite board liner would not transfer any measurable amount of grain pressure further than the immediately adjacent bands.

The last step was to calculate the average lateral pressure for each of the loading areas from its corresponding band tension. As

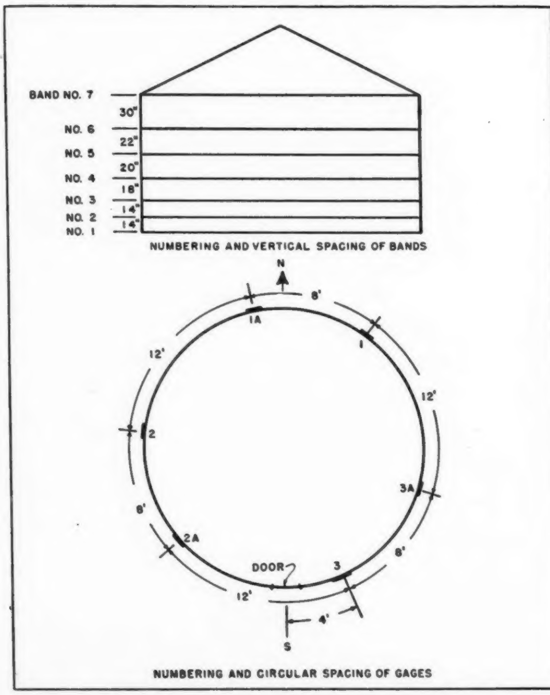


Fig. 3 Location and numbering of strain gages

TABLE 2. BAND UNIT STRESSES AND TENSIONS

		Height of Wheat		
Band	Item	6 ft 6 in	8 ft 3 in	9 ft 8 in
	Average gage difference	68	72	133
1	Stress, psi	1972	2088	3857
	Band tension, lb	246	261	482
	Average gage difference	298	335	455
2	Stress, psi	8642	9715	13195
	Band tension, lb	1080	1214	1649
	Average gage difference	272	327	479
3	Stress, psi	7888	9483	13891
	Band tension, lb	986	1185	1736
	Average gage difference	214	291	445
4	Stress, psi	6206	8439	12905
	Band tension, lb	776	1055	1613
	Average gage difference	76	209	381
5	Stress, psi	2204	6061	11049
	Band tension, lb	276	757	1381
	Average gage difference		69	281
6	Stress, psi		2001	8149
	Band tension, lb		250	1019
	Average gage difference			109
7	Stress, psi			3161
	Band tension, lb			395

Cross sectional area of band 0.125 sq in
Modulus of elasticity for band, 29×10^6 psi

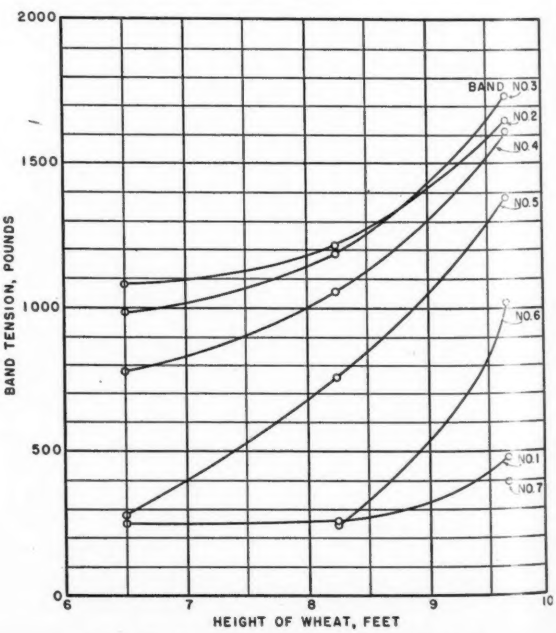
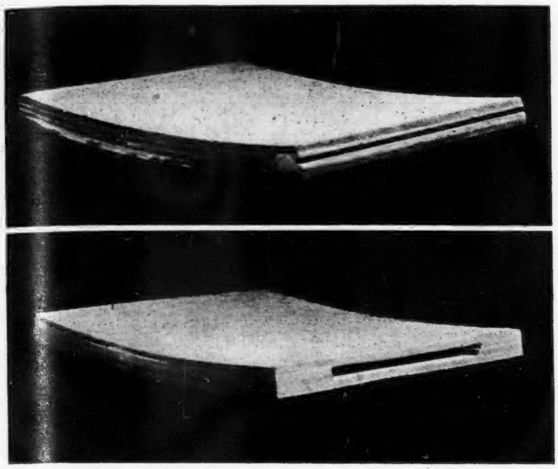


Fig. 4 Band tensions for various heights of wheat



Top: **Wall panel of the Thermo-Seal grain bin showing grooved upright along one edge • *Bottom:* The same panel cut away to show inside and outside Graylite (Insulite) board and Graylite filler strips which occur at each band location.**

a typical calculation, the lateral pressure P_6 is equal to $(144 \times 1019)/(114.5 \times 23)$, or 55.7 lb per sq ft. These values for the lateral pressure at various depths of wheat are tabulated in the right-hand column of Fig. 5, and are shown graphically in Fig. 6.

The strain gage readings taken at gage 1A on bands 2, 4 and 7 before and after the opening of the grain door were identical, indicating that there was no change in lateral pressure at a point opposite the door due to the flow of wheat from the bin.

Discussion. It may be well to point out that in the following discussion any conclusions to be drawn from the determination of band tensions and lateral pressures made in this test apply particularly to this bin and not necessarily to bins of other shapes, sizes and materials or to wheat of a different weight or moisture content.

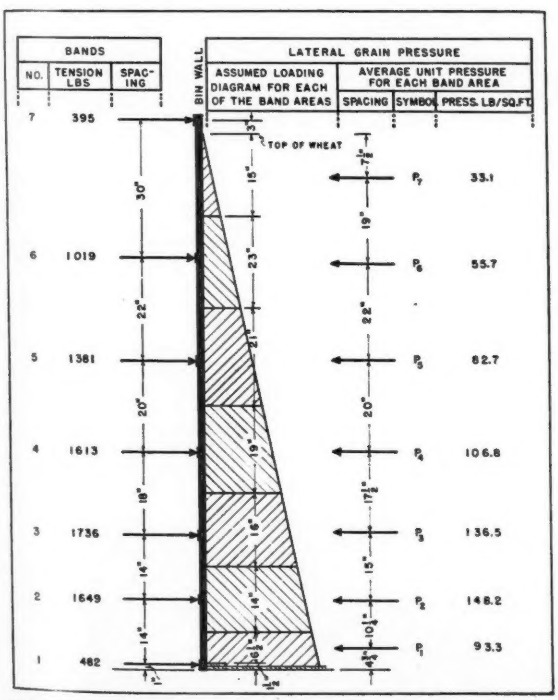


Fig. 5 Analysis of lateral grain pressure

Fig. 6, in addition to the curve showing the values for lateral pressure determined by this test, also has the following:

1 A curve based on the results of Dr. Andersen's test of August 29, 1942 (curve D).

2 A curve taken from the values on Fig. 7 for a bin with the same hydraulic radius as this one. These design values were calculated by Janssen's formula (also shown on Fig. 7) using 49 lb per cu ft for W, the weight of the wheat, 0.400 for U', and 0.5 for K (curve A).

3 A curve using values calculated by Janssen's formula and based on the same factors as used for (2) above except that W was taken as 45.8 lb per cu ft, the actual average weight of the wheat stored in the bin under test (curve B).

It will be noted that both the 1942 and 1944 test results determine quite smooth curves, though in both cases the lateral pressures determined at P_7 (a depth of 0.6 ft) and at P_1 (a depth of 9.3 ft) deviate from their respective curves. In the case of P_1, which is calculated from the tension in the bottom band, it is very possible that certain elements of the bin and details of construction tend to relieve this band of a part of the pressure existing at the bottom of the bin with the result that the apparent lateral pressure is considerably lower than would be expected. The weight of the bin wall, together with the vertical pressure of the wheat on the wall, would cause an appreciable frictional force where the wall rested on the floor framing. As this force would tend to relieve the tension in the lower band, this is probably the explanation for the best results obtained.

At P_7, the lateral pressure is calculated from the tension in the top band. In both tests, these values are somewhat higher than would be expected. The top band probably carries the major portion of the horizontal thrust from the roof in addition to wheat pressure. However, unless there is a change in the amount of this thrust between the full and empty conditions of the bin, it would not affect the band tension as measured by the strain gage readings, since for both conditions these readings would include the roof thrust. Other than the possibility of a change in this roof thrust, no apparent reason for the high values for the top band tension was found.

Referring to the curves of the actual values for lateral pressure determined in 1942 and 1944 shown on Fig. 6, it is noted that the values for 1944 are greater than those for 1942. The amount

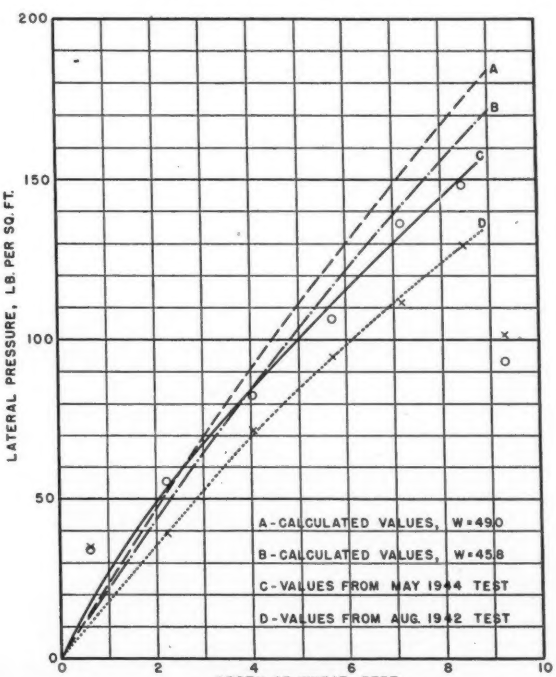


Fig. 6 Comparison between lateral grain pressures as determined by test and by calculation

of this increase (i.e., the difference between these two curves) can be expressed very closely by the relationship $Y = 1.25X + 10$, where Y is the increase in lateral pressure in pound per square foot and X is the depth of wheat in feet. This definite relationship between the two determinations indicates that there was an actual increase in the lateral pressure as measured over a period of approximately 20 months and that the differences between the two results were not caused by inaccuracies in either or both of the determinations.

There are several reasons for changes in grain pressure in a bin. Among these are changes in moisture content of the grain, changes in temperature of the grain, changes in the shape or size of a bin due to temperature changes, settlement of the grain, and disturbance of the grain such as caused by probing and vibration.

Of these causes, some can be ruled out. During the storage period, seven determinations of the moisture content and test weight were made, the results of which are given in Table 1 of the appendix to this report. The moisture content averaged 12.4 per cent, with a range of 12.2 to 12.6 per cent, and the weight averaged 57.0 lb per bu, with a range from 56.8 to 57.2. As these slight variations normally occur in securing a composite sample from a bulk of grain as large as stored in this bin, they are not significant and would not cause measurable changes in the grain pressure.

There is no record of the grain temperature at the time of either of these tests, this record having been kept from November, 1942, to April, 1944. The temperature record is given in Table 2 of the appendix. The average grain temperature for September 1, 1943, was about 40F higher than for May 1 of the same year. From this it may be assumed that any effect from grain temperature upon the 1942 and 1944 pressure determinations would be in the direction of making the 1942 results the higher.

On the other hand, the air temperatures occurring during the first part of May, being lower than those occurring during the latter part of August, would tend to tighten the steel bands on the bin with a resultant apparent increase in the lateral pressure of the wheat as measured in 1944 over that in 1942.

There is evidence to show that disturbing grain as by probing tends to lessen the lateral pressure. The grain in this bin was sampled a total of six times during the period between 1942 and 1944 tests. However, the grain would settle after each probing and it is reasonable to assume that the net result was an increase in the lateral pressure.

Vibration very probably had little effect upon the grain in this bin. No railroad is located adjacent to the bin site and the traffic on a near-by highway could very probably be ruled out.

It was interesting to note that in this particular bin there was no increase in the lateral pressure at a point opposite the opening from which grain was flowing.

The values for the lateral pressure of wheat calculated by Janssen's formula (Fig. 7) appear to be safe to use for design purposes. Since this graph was primarily intended for this purpose, the values for the factors in the formula were estimated with a view to determining safe design loads. These values were:

W, weight of wheat, 49 lb per cu ft
U', coefficient of wheat on Insulite, 0.400
K, ratio of lateral to vertical pressure, 0.5.

As the lateral pressure calculated by the formula increases with a decrease in U', it is better for design purposes to assume a low value for this factor. A consideration of the values for U', determined by different experimenters (Table 3, appendix) indicates that a value of 0.400 for wheat on Insulite is conservative.

K has a calculated value of 0.458 when the following values are substituted in Janssen's formula: U', 0.400; H, 8 ft; L, 144.5 lb per sq ft; R, 4.77; W, 45.8 lb per cu ft. With the exception of U', these values are taken from the 1944 test results. As the lateral pressure calculated by the formula increases as K increases, a value somewhat higher than 0.458 would be better for design purposes. Using a value of 0.5 for K (U' at 0.400 and H at 8) will give a lateral pressure about 7 per cent higher than the actual pressure determined in 1944. This value for K is therefore considered a safe one to use.

CONCLUSIONS

1 There are variations in grain pressures within a bin or band tensions for a bin such as the one tested even under normal storage conditions.

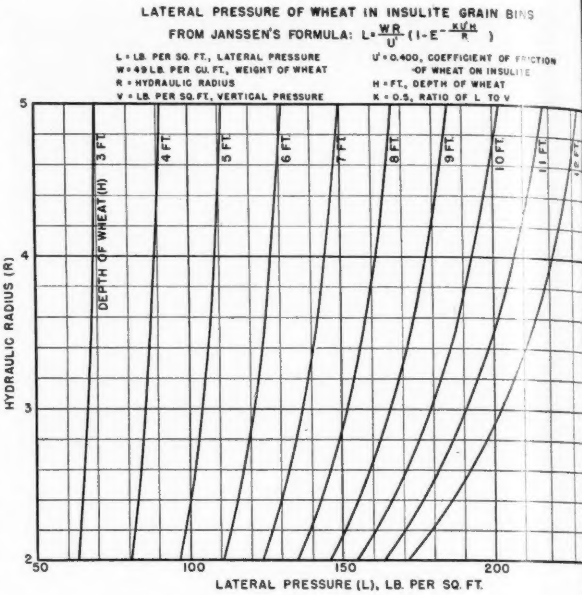


Fig. 7 Design wheat pressures for Insulite grain bins

2 Janssen's formula may be used to determine safe design pressures.

3 Safe values for factors in Janssen's formula in designing shallow Insulite bins for wheat storage are:

(a) Weight of wheat, W: 49 lb per cu ft
(b) Coefficient of friction of wheat on Insulite walls, U': 0.400.
(c) Ratio of lateral to vertical pressure, K: 0.50.

APPENDIX

TABLE 1. OFFICIAL GRADE TESTS ON AVERAGE SAMPLES OF THE WHEAT STORED IN THE THERMO-SEAL BIN

Date	Moisture per cent	Test weight, lb per bu
Nov. 23, 1942	12.4	56.8
Feb. 2, 1943	12.6	56.9
May 10, 1943	12.4	57.1
Aug. 12, 1943	12.5	57.0
Nov. 27, 1943	12.4	57.0
Feb. 14, 1944	12.2	57.2
May 4, 1944	12.5	56.8

TABLE 2. TEMPERATURE OF THE WHEAT STORED IN THE THERMO-SEAL BIN

Date	Temperature, degrees Fahrenheit A	B
Nov. 24, 1942	43	48
Dec. 12, 1942	22	31
Dec. 24, 1942	24	32
Feb. 7, 1943	15	21
Mar. 3, 1943	19	18
May 4, 1943	42	32
June 12, 1943	55	43
Aug. 3, 1943	77	62
Oct. 12, 1943	69	61
Nov. 12, 1943	44	43
Dec. 19, 1943	31	38
Feb. 26, 1944	23	26
Apr. 5, 1944	29	25

NOTE: "A" is the average of the temperature 2 ft from the south wall at the floor and the temperature at the center of the bin at floor, and "B" is the average of the temperature 2 ft from the south wall 2 ft below the surface of the wheat and the temperature at the center of bin 2 ft below the surface of the wheat.

TABLE 3. VALUES FOR COEFFICIENT OF FRICTION OF WHEAT ON VARIOUS TYPES OF BIN WALLS (U') FROM "WALLS, BINS, AND GRAIN ELEVATORS", BY MILO S. KETCHUM

Authority	Surface	U'
Jamieson	Steel flat plate, riveted and tie bars	0.375 to 0.400
	cement-concrete, smooth to rough	0.400 to 0.425
	tile or brick, smooth to rough	0.400 to 0.425
	cribbed wooden bin	0.420 to 0.450
Airy	Rough boards	0.412
	smooth boards	0.361
	iron	0.414
	cement	0.444

Automatic Feed Control for Feed Grinders

By Howard F. Carnes

JUNIOR MEMBER A.S.A.E.

THE development of an automatic feed-control device for feed grinders as described in this paper was the result of an attempt to secure uniform feeding of a small hammer mill with grain containing an unusually large amount of straw, weed stems, and other foreign material.

The equipment selected was a small hammer mill powered by a ½-hp electric motor. The motor was of the repulsion-induction type, 1800 rpm, with the swinging hammers of the mill driven by a V belt. The hammer mill speed was approximately 3500 rpm. The first attempt to secure automatic feed regulation was by use of a vibrating feed table. With reasonably clean grain this method proved fairly satisfactory, but any large pieces of straw mixed with the grain would tend to reduce or in some cases entirely stop the flow of grain to the hammer mill. The small quantity of grain flowing over the vibrating feed table made it necessary to have the variable throat opening above the table closed so much that it was impossible to secure absolute dependability and trouble-free operation with this type of feed mechanism. To overcome this difficulty the hammer mill was reconstructed as shown in Fig. 1.

The variable-feed mechanism consists of a swinging gate or valve placed in the rectangular section of the feed hopper directly above the grinder. The motor driving the mill was mounted in a cradle which was pivoted so that the center of rotation of the cradle was on the exact same center of rotation as the motor shaft. Mounted in this manner the motor base and motor housing tend to rotate in a direction opposite to that of the motor shaft. If the motor and cradle in which the motor was mounted were balanced, rotation of the motor housing would result when the motor was turned on. However, since there was considerable weight in the base of the motor and that part of the cradle supporting the motor which is below the center of rotation, any tendency of the motor base to rotate is counterbalanced by a torque acting to oppose rotation.

Torque is defined as the product of a force times the lever arm at which that force acts. In the case of the feed grinder described, the torque developed by the motor shaft was balanced by a torque due to the weight of the motor base. Since the pull of gravity on the motor base acts vertically downward, when the motor base is in the normal position the torque would be zero since the lever arm of the force would be zero. If the motor is rotated 90 deg in either direction, the force or weight of the base remains the same but the lever arm of that weight is now at a maximum thus producing the maximum torque tending to return the motor back to its normal position. Thus this torque varies from zero with the motor in its normal position to a maximum with the motor rotated 90 deg.

This resisting or balancing torque could also be obtained by means of a tension spring. The controller shown in Fig. 1 was constructed so that the extra weight of the motor base was counterbalanced by an additional weight supported above the motor. Then to obtain a resisting torque a tension spring was fastened between the fixed and rotating motor base. However, the other controller constructed with the weight of the motor bases itself and the weight of the rotating framework supporting the motor as a means of obtaining a resisting torque seemed to work equally as well and construction was somewhat simplified.

It follows then that since horsepower is defined as the product of torque times speed, or rpm, the torque required of the motor in grinding feed is directly proportional to the horsepower output of the motor since the speed of the motor is constant.

The torque on the motor shaft varies directly and instantaneously with the amount of grain fed to the grinder. In order that the resisting torque of the motor base equal at all times the torque on the motor shaft, the motor base must rotate either to increase or decrease the lever arm of the resisting force caused by the weight of the motor base. It is this rotation which is made to actuate the feed-regulating valve to the grinder.

An arm extends out from the valve in the feed hopper of the hammer mill. From this arm a rod was connected to a suitable point on the rotatable motor base. By experimenting the proper length of connecting link was secured so that feed regulation to the mill was as desired.

Referring to the hammer mill shown in Fig. 1, it was found that with the motor running and no grain being fed to the mill the motor would rotate about 5 deg from its standstill position. At normal load of ½ hp, rotation would increase to 20 deg, and with an increase of load to 150 per cent of rated motor horsepower the rotation amounted to 30 deg. The gate valve was connected so that with no load on the motor the valve would be straight down or wide open giving a maximum open-

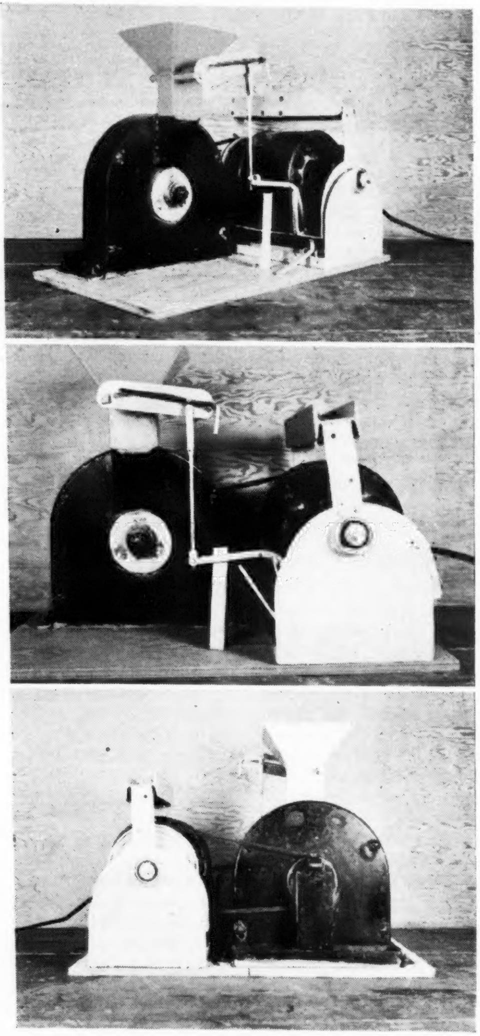


Fig. 1 Hammer mill equipped with feed control and powered by a ½-hp electric motor. *Top:* The hopper is supplied from an overhead grain bin. The movable motor base is balanced by a counterweight above the motor and a tension spring is used to provide a resisting torque. This view shows the locking device in the locked position and the regulating valve completely closed. *Center:* This view shows the motor base rotated so that the valve is in the open position. Notice that the center of the arc of the curved slot in the valve arm has shifted to the left. Movement of the upper end of the connecting linkage to the left will now open the valve for grains requiring a wider gate opening. *Bottom:* This is a rear view of the hammer mill. Although the mill is powered by a ½-hp motor, it can be left unattended for several hours at a time when equipped with a feed controller. During the past two years this hammer mill has supplied all the ground grain for 25 cows, 1000 turkeys, and other livestock around the farm

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

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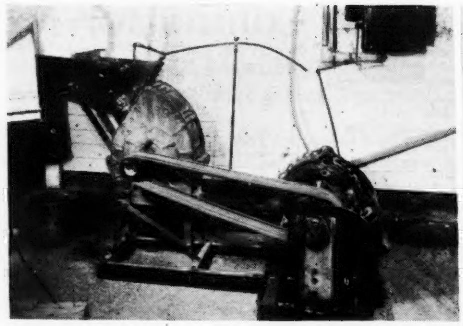
EDITOR'S NOTE: An application for patent has been filed covering the automatic feed-control device described in this paper.

ing for passage of grain or any short pieces of straw which might be mixed with the grain. With a definite overload on the motor the valve was positioned to close entirely the feed opening to the grinder.

A method of locking the motor base in the overload and also the no-load positions was devised. It was found necessary to have the motor locked in one or the other of these positions when starting to prevent the sudden high torque developed by the motor from damaging the linkage connected to the gate valve. Locking of the motor base in either the overload or no-load position also opens a switch in the motor circuit stopping the motor. Thus if the grinder is overloaded either by mechanical failure of some part or too wide open, a setting of the feed-regulation valve admitting grain faster than the mill will handle it, the added torque on the motor will shut off the power before the motor is damaged. Likewise, if for some reason the load on the motor decreases, such as it would when the supply of grain runs out, the motor is automatically stopped.



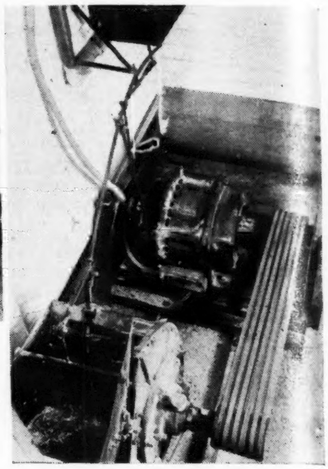


Fig. 2 These views show a controller built for use with a 10-hp motor which drives a hammer mill in the Oregon State College dairy barn. *Above:* The weight of the motor base provides the resisting torque to operate the gate valve. A push rod connected to the locking device at the lower right of the motor base is used to trip the switch and stop the motor. Just above the locking handle can be seen a pointer attached to the movable motor base which enables the operator to adjust the feed-gate opening for correct load on the motor. *Right:* View of hammer mill and controller showing attachment of control lever to adjustable gate of original hopper. The curved slot in the lever arm, as shown in Fig. 1, is here replaced by a curved rod with a sliding connection to obtain different amounts of opening of the feed gate as required for various grains

Since nearly every feed grinder is adapted to handle several different kinds of grain, it was necessary that some means of adjustment of the feed-regulation valve be made for each different grain. The motor mounted in a cradle as previously described rotated a certain number of degrees from its standstill position when loaded to rated capacity. The amount of rotation to produce the rated horsepower of the motor was determined by use of electrical measuring instruments. This degree of rotation could also have been determined by measuring the resisting torque with a spring balance. Once the position of the motor cradle with reference to the stationary motor support had been determined for 100 per cent load on the motor this point was marked for future reference. Then for grinding different grains requiring various sizes of feed openings it was only necessary to regulate the adjustment on the gate valve admitting more or less grain to the grinder until the motor base rotated the proper number of degrees indicating 100 per cent load on motor.

For the controller illustrated in Fig. 2 a wooden pointer about 3 ft long was attached to the rotatable motor base and a scale marked on the wall behind the pointer. This helped the operator to adjust the opening of the feed gate valve until the motor rotated to a point on the scale indicating 100 per cent load on the motor.

The arm extending from the gate valve has a curved slot several inches long in it as can be seen in Fig. 1. The purpose of this was to provide an adjustment of the valve for different grains and yet have the valve shut off and completely stop the flow of grain when the motor base was locked in the overloaded position. In the overloaded position the pivot point of the lower end of the connecting linkage between the valve arm and the motor base is at the center of curvature of the slot in the valve arm. In this position the upper end of the connecting link can be moved the full length of the slot without imparting any movement to the gate valve. Thus regardless of the position along the slot of the connecting link the valve can be made to return to the closed position when the motor base is locked in the overloaded position. Any rotation of the valve arm as when the valve is partly open or in normal running position, will shift the center of curvature of the slot in the arm to some point other than the pivot point of the connecting link on the motor base. If the upper end of the connecting link is now moved along the slot, the gate valve will be opened or closed to give the adjustment required for the various grains.

Two controllers, as described above were built and put into operation in 1943-44. Both were used on hammer mills. One ½-hp motor operated the belt-driven hammer mill shown in Fig. 1. Then to determine the suitability of this means of feed control for larger hammer mills, a controller was built using a 10-hp motor as shown in Fig. 2. Both controllers operated entirely satisfactorily under conditions found in actual use.

The ½-hp motor was started and stopped by means of a snap switch of the mercury type mounted on the rotating motor base. Instead of moving the toggle lever of the switch to the "On" or "Off" positions the entire switch was mounted so that it would rotate about a pivot point. When the motor base would lock in either the overload or no-load position, the action of the locking device released the switch assembly allowing it to rotate and break the motor circuit. To start the motor again the switch was rotated back into running position and the locking device released after the motor had started. The locking device then held the switch in the proper running position until it was desired to stop the motor again. A suitable means of operating any other type of switch from the locking device could easily be worked out.

In the operation of the hammer mill it was found desirable, although not essential to successful operation, to provide a means for closing the feed-regulating valve when the motor stopped in the underload position. This occurs when the hopper becomes empty. If for some reason the grain flow to the mill was temporarily interrupted, the motor would stop leaving the valve wide open; then when the grain started flowing again, the hammer mill would not be operating but with the valve open the mill would fill up with unground grain necessitating cleaning out of the machine before it could be started. To prevent any trouble of this sort a latch arrangement on the feed-regulating valve was devised. When the valve swings to a wide-open position a stop fastened to the main part of the hopper pushes the latch out of engagement with its notch. A tension spring causes the valve to rotate to the closed position. When starting the machine again the motor is turned on and then the motor base rotated to the overload position where the latch will engage its notch and open the valve to normal running position.

The controller built to operate with the 10-hp motor required a somewhat different method of starting and stopping the motor. This particular motor required a starting compensator operated manually for starting. When the lever on the starting mechanism was pulled to the "Run" position it was held in place by a catch. A system of levers operated by the locking device on the motor base was made to act through a push rod to release this holding catch on the starting box and automatically stop the motor.

The hammer mill powered by the 10-hp motor described above and shown in Fig. 2 was equipped with a V-belt-driven blower for elevating the ground grain into overhead bins. The height of elevating required was such that unless care was taken to keep the feed to the mill below capacity of the hammers, the blower would clog and damage the V-belts unless an operator were there to stop the machine. After installing the controller, if the operator set the feed heavier than the blower would handle, the additional torque on the motor caused by plugging of the blower would trip the motor switch and stop the machine before the belts were damaged. Another advantage of the controller on this hammer mill was a saving of the operator's time. The grain was fed to the hammer mill through a long sloping chute of considerable capacity with a shutoff near the top of the chute. After (Continued on page 330)

Kostiakov on Prevention of Waterlogging and Salinity of Irrigated Land

By D. B. Krimgold
MEMBER A.S.A.E.

(The May-June, 1944, issue of "Sotzialisteheskoe Khoziaistvo", official organ of the Narkomzem (department of agriculture) of the USSR, carried a 10-page article by A. Kostiakov on this subject. His discussion of the problems and recommendations are much the same as are found in our own literature. Some of his analyses and limiting values cited in connection with quantitative expressions may, however, prove helpful to irrigation and drainage engineers in the United States.

Kostiakov is a member of the Academy of Agricultural Sciences and chief consultant of the USSR government on subjects relating to irrigation and drainage. His analyses and recommendations are apparently based on extensive irrigation investigations carried out within the last decade in various parts of the USSR. I have read a number of articles describing this work and was impressed with the thoroughness and scope of the investigations and with the conclusions drawn from them.—D. B. KRIMGOLD.)

ACADEMICIAN Kostiakov states that salinity and waterlogging are closely interrelated and are governed by two basic sets of factors, namely, (1) by high levels of mineralized ground water and excessive amounts of irrigation water and (2) by unfavorable condition of the soil (lack of crumb structure) and high content of water-soluble salts (chlorides and sulfates of Na, Mg, Ca and others).

Preventive measures must be directed toward the elimination of the principal causes of salinity and of waterlogging, and must include:

1 Creating and maintaining the necessary crumb structure of the soil, decreasing evaporation from the soil and preventing accumulations of salts in the surface soil.

2 Preventing a rise in the water table and excluding excessive amounts of ground and surface water.

The first group of measures are, in Kostiakov's opinion, obtainable by following the grassland system of agriculture in accordance with the teachings of Academician V. R. Williams[1]. The second group of measures consists largely of proper use of irrigation water and of the irrigation system.

Crop rotation, including grasses and properly managed alfalfa, is the most important means of creating and maintaining a crumb structure and reducing evaporation from soils. Irrigation water must be applied in such a manner as not to destroy the structure of the soil. Work of the Ak-Kavakska (UZBEK SSR) Experiment Station shows that the number of aggregates greater than 0.25 mm was doubled after only one year of alfalfa and was increased from 5 to 8 times during the entire rotation. The improvement in soil structure and the shading produced by the plants result in a reduction in evaporation and in the movement of salts into the upper layers of the soil. Observations at the Zolotoordinsk Experiment Station show that under alfalfa there is practically no accumulation of salts during one growing season, while on a plowed field the salt content increased fivefold during the same period.

The level of ground water (water table) must be kept at depths not less than 1.5 to 2.5 m (5 to 8.25 ft) depending on the salt content of the ground water, structure of the soil, and cropping practices. For clay soils, these depths should not be less than 2 to 2.5 m (6.5 to 8.25 ft). After leaching, the depths to the water table should not be less than 1.3 to 1.8 m (4.3 to 6 ft) and should be allowed to remain at this level only for short periods. Continuous records of the depth to the water table must be kept and the dynamics of fluctuations must be analyzed on each irrigated area. Irrigated land must be classified in accordance with its hydrologic and soil characteristics.

Where surface water does not remain on the land, the balance of ground water in an entire irrigation system for a given period (such as a year) is expressed as follows:

$$100\, d\, \Delta H = \Delta M + aS + g - R \qquad [1]$$

Where d is the difference between total water at saturation and the "ultimate field-moisture capacity", expressed in per cent

ΔH is the range in elevation of ground water (water table) during the period

S is the seepage loss from canals, per unit of irrigated land

a is a coefficient which determines how much of the seepage reaches the water table and is assumed to vary from 0.6 to 0.9

g is ground water inflow from adjoining areas (Such inflow may or may not exist)

R is outflow of ground water into natural channels or into drainage canals

$\Delta M = M + P - (E + E_0) + \Delta W$, where M is the amount of irrigation water applied, P is precipitation and condensation, $E + E_0$ is evapo-transpiration, and ΔW is the difference in soil moisture at the beginning and end of the period.

In the above equation, M, S, g, and R are in cubic meters per hectare (acre-feet per acre or feet or inches in English units); H is in meters (feet or inches), and d is in per cent.

Kostiakov does not define the term "ultimate field-moisture capacity" which he uses freely in his article. A good idea of the meaning of this quantity and how it is determined can be obtained from the following quotation from "Sprinkler Irrigation of Orchards in the Crimea" by Engineer A. I. Michalovski (pages 60-75 of "Dozhdevanie", vol. III, Moscow, 1940):

"The ultimate field-moisture capacity was determined under field conditions in the following manner: Three plots, each with an area of 25 sq m, were set up between the rows of trees. A fourth one of the same area was established around one of the trees. These plots were flooded with 2,000, 3,000 and 4,000 cu m per hectare (20, 30, and 40 cm or 8, 12, 16 in). Soil moisture was determined in triplicate within each of the plots to a depth of 1½ m. This was done prior to the application of water and at intervals of 12, 36, 84, 132 and 240 hr subsequent to the application of water. In all cases the most stable moisture content was observed between 84 and 132 hr after the application of water. Beyond these periods the moisture begins to decline. The ultimate field-moisture capacity was therefore taken as the mean for all plots at 84 and 132 hr after application."

The equations given above show which of the factors must be considered. They show that, first of all, it is necessary to reduce ΔM and aS, and to provide adequate outflow, R. This can be accomplished by (1) limiting the quantities of irrigation water to the amounts required by plants and making sure that it does not exceed the soil-moisture deficit both during the summer and the fall-winter seasons, (2) reducing seepage from canals, (3) exclusion or timely removal of surface water resulting from runoff from adjoining areas, floods, or torrential rains, (4) reducing the capillary rise of ground water by lowering the water table and maintaining a crumb structure of the soil, thus preventing accumulation of salts in the upper layers of the soil, and (5) increasing water utilization through higher crop yields, while at the same time shading the soil and reducing evaporation from the soil, thus reducing the rate of upward movement of water-soluble salts.

In many cases, these measures will be sufficient not only to reduce or eliminate the rise of the water table but even to lower it. Where these measures are insufficient, it is necessary to increase artificially the ground-water outflow by means of adequate drainage. However, drainage must not replace but should supplement the aforementioned preventive measures.

Kostiakov points out the close relation between salinity and

This review of a technical paper in the Russian language was prepared expressly for AGRICULTURAL ENGINEERING.

D. B. KRIMGOLD is soil conservationist (runoff studies), Soil Conservation Service, U. S. Department of Agriculture.

[1]Kostiakov is a student and faithful follower of Williams, a Russian-born son of an American railroad engineer. Williams is apparently the Soviet Union's outstanding authority in agricultural science, especially in the fields of soils, grasses, and pastures.

waterlogging and states that preventive measures must be carried out both on the entire irrigation system and on the individual irrigated areas. He gives the following expression for amounts of water to be applied to individual fields in one irrigation which he designates m:

$$m = bAH \qquad [2]$$

Where b is the moisture deficit, in per cent, of "ultimate field-moisture capacity". (It fluctuates 20 and 30 per cent depending on frequency of irrigation.)

A is the "ultimate field-moisture capacity", in per cent by volume and is governed by the characteristics of the soil. (For loess soil, it varies from 26 to 40 per cent and constitutes from 70 to 75 per cent of the total pore space.)

H, in meters, is the depth of soil which is to be wetted by irrigation. (It depends on the extent of the root zone of the irrigated crop at a given time and may therefore be smaller during early stages of growth than later in the growing season but should not be less than .035 to 0.40 meters [14 to 16 in]. It must also be less than the depth to the salt-bearing layer of the soil. The value of H may therefore vary from 0.35 to 1.0 m [14 to 40 in]).

For illustrative purposes, Kostiakov gives the following values of m:

QUANTITIES OF INDIVIDUAL IRRIGATIONS "m", IN INCHES, FOR VARIOUS SOIL CHARACTERISTICS, DEPTHS OF ROOT ZONE, AND MOISTURE DEFICITS

Total porosity of soil, per cent by volume	Ufm*, per cent	$H = 20$ in		$H = 30$ in			$H = 40$ in	
		$b = 25$	$b = 30$	$b = 20$	$b = 25$	$b = 30$	$b = 20$	$b = 25$
40	30	-	1.8	1.8	2.2	2.6	2.4	3.0
45	32	1.6	1.9	1.9	2.4	2.8	2.5	3.2
50	36	1.8	2.1	2.1	2.6	3.2	2.8	3.5
55	40	2.0	2.4	2.4	3.0	3.5	3.2	3.9

*Ultimate field-moisture capacity.

This table shows that irrigation quantities can be greater when the moisture deficit is higher. It is not advisable to allow the deficit to become greater than 30 per cent of the "ultimate field-moisture capacity", especially on soils with high salinity because harmful concentration of the soil solution may result. It is better if the deficit does not exceed 25 per cent. The required total amount of water should therefore be supplied in small amounts at frequent intervals. In case of surface (furrow) irrigation, however, the individual amounts should not be less than 400 to 500 cu m per hectare (1.6 to 2 in) in order to avoid appreciable losses by evaporation.

The total amount of irrigation water for an irrigation season must correspond strictly to the amount required to produce the yield attainable with the given soil fertility and cropping practices employed. This amount designated M is expressed as follows:

$$M = (E + E_0) - P - \Delta W \qquad [3]$$

Where P is the amount of precipitation entering the soil during the season

ΔW is the difference in soil moisture at the beginning and end of the irrigation season plus the amount of ground water which entered the root zone during this period by capillary and film action. (For irrigated areas with depth to ground water greater than 2.5 m (8.25 ft), the amount thus entering the root zone is relatively small and can be neglected. For depth to ground water less than 2 m (6.5 ft), this amount ranges from 5 to 25 per cent of $(E + E_0)$, increasing with a decrease in depth to ground water and with the fineness of soil texture.)

E and E_0 are the amounts transpired by the crops and evaporation from the soil, respectively. (They are closely interrelated and depend on crop yields. They can therefore be treated together and can be expressed as the product of the expected yield and the "coefficient of water utilization," the latter being the amount of evapo-transpiration per unit of crop yield.)

The values of the coefficient of water utilization must be obtained from irrigation experiment stations in each region. As an example, Kostiakov gives the following values of the coefficient for cotton and alfalfa under the semiarid condition in Central Asia:

Cotton				
Yield (seed cotton), tons per acre	.90	1.35	1.80	2.25*
Coefficient, acre-feet per ton	0.97	1.78	1.54	1.38
Alfalfa				
Yield, tons per acre	2.70	3.60	4.50	5.40
Cofficient, acre-feet per ton	1.13	.93	.77	.70

"These coefficients should be increased by 10-20 per cent for dry years and decreased by 15-20 per cent for wet years".

*Kostiakov does not comment on these high yields, neither does he describe the experiments on which these values are based. Inquiries of the Soviet Purchasing Commission revealed that in Central Asia two crops of cotton per year are not uncommon. This readily explains what appear to be abnormally high yields.

Equation [3] shows that the seasonal irrigation quantity M is directly related to the yields of the irrigated crops. It follows that irrigation quantities must not be high when fertility and cropping practices are poor and anticipated yields are consequently low.

With the foregoing analysis as a basis, Kostiakov lists a number of recommendations most of which are accepted as good irrigation practices in the United States. Some of his recommendations which may not have been too strongly emphasized in our literature include the following:

1 *Diversion from the Source.* The quantities delivered to an irrigation system must correspond strictly to the area to be irrigated and to anticipated crop yields which are determined by soil fertility and cropping practices. He points out that on many irrigation systems in the cotton regions, diversions amount to from 63 to 84 in per year instead of the required 43 to 48 in.. The excess water feeds into ground water. Diversions must be regulated not only during dry years but even more strictly during wet years when water is plentiful.

2 *Operation of Canals and Laterals.* Seepage should be reduced by cultivating and compacting the wetted surface of canals which carry water intermittently. Operation of canals and laterals during the winter must be carefully regulated as seepage losses during the dormant season go almost exclusively to ground water. During the winter, water should be excluded from irrigation canals even if water from wells and ponds must be used for livestock and domestic purposes. Leaching periods must be definitely fixed and the flow in canals stopped as soon as the work is completed. The level of water in drainage ditches should in most cases be not less than 2 m (6.5 ft) below the ground surface; higher levels are permissible only for short periods.

3 *Cropping and Tillage.* Cropping and tillage practices on irrigated land must be of the highest order necessary to create and maintain a crumb structure of the soil and to obtain high yields. This can be accomplished by crop rotations, including grass and alfalfa, use of organic fertilizers (manure), proper plowing and frequent cultivation and shading of the soil to reduce evaporation, establishment of shelter belts along irrigation ditches, and application on alkali soil of soil amendments such as gypsum and sulfur.

4 *Irrigated Rice Fields.* Irrigated rice fields should not be scattered among other irrigated fields, as each hectare of rice may raise the water table on from 5 to 7 adjoining hectares (12.5 to 17.5 acres). Rice areas must be isolated and provided with separate irrigation and drainage ditches.

Kostiakov states that the foregoing and the other well-known practices mentioned in his paper constitute good preventive measures against waterlogging as well as against salinity. However, where salinity has been permitted to develop or where it existed prior to irrigation, leaching is necessary. Leaching quantities for medium salinity should be from 2,000 to 5,000 cu m per hectare (8 to 20 in) depending on the depth to the water table and on the moisture-holding capacity of the soil. If these quantities are not sufficient, the application should be repeated the following year. The total amount of leaching water should be applied in 2 or 3 stages. In the first stage, only enough is applied to bring the moisture up to "ultimate field capacity" so that the salts may be dissolved. Four or five days afterwards, the remainder of the water is delivered in one or two applications to wash out the dissolved salts. Leaching should be carried out in the fall-winter period when evaporation and the moisture deficit are low. On adequately drained areas, higher leaching quantities can be used and the task completed in a shorter time.

Kostiakov recommends the establishment of properly referenced groundwater observation wells on each irrigation system. Observations must be at 5-day intervals during the growing season and at 10-day intervals during the rest of the year. The records must be compiled and analyzed currently in order to serve as a guide for regulating the water and salt regime of the irrigation system.

The Portable Elevator-Conveyor

(Continued from page 320)

ber would be astounding. The value of the man-hours saved (and farm labor is now costly) compared to the operating cost of five cents per thousand bushels of grain is an advantage that many farmers cannot afford to overlook. We must produce more with less farm labor. The elevator-conveyor will eliminate at least two men from the job of moving grain on an average farm. A customer in the territory we serve is proud to know and testify that he eliminated five men, two wagons and one team from the grain storage job at threshing time. Mr. Eddie McCrea, whose farm is a few miles north of Bad Axe, Michigan, purchased the second elevator made in Eastern Michigan. The elevator was 4 in wide and 20 ft long, and has done a good job since the fall of 1939.

THE FARM ENGINEER HAS A HOST OF PROBLEMS PRESENTED FOR SOLUTION

The farm engineer is called upon to help both farm and city customer. Through these contacts a host of problems are presented to him for solution. Not unlike a doctor, the farm engineer must have a good cure for many ills to be successful in his profession, and to secure the confidence of his customers. When something new is presented to the farm engineer he must, before promoting its use, be reasonably sure this customer will benefit from the use of that new equipment. Having the confidence of a customer, the farm engineer should make an installation, using the correct equipment for the particular conditions prevailing on that customer's farm. We can be assured of getting covered with dust and dirt, but experience with an actual problem is valuable and insures the success of future installations. When the results of the first installations are known and proven satisfactory, it may be necessary to demonstrate a model at county fairs, at 4-H Club and F.F.A. fairs, and even on vacant lots in small communities. The farm service division of The Detroit Edison Company closely followed this program, and interest in the portable elevator-conveyor soon was evidenced by articles appearing in local newspapers and requests for information from farmers. A photograph and explanation of the possibilities of this equipment along with sound advice on proper motor capacities to be used, were presented to all of our farm customers in our monthly farm bulletin.

Previous experience has proven that the best method to be used to get such equipment into the hands of the farmer was to have it manufactured and sold locally. Several lumber yards, which were not busy at the time, were contacted. They were quick to see the possibilities and began the construction and demonstration of the elevators.

The results of our activities since the fall of 1939 are very gratifying. Lumber-yard and machine-shop owners have sold over five hundred ready-made portable elevator-conveyors to date. An estimate made by contacting county agricultural agents and farmers has indicated an additional one hundred elevators were made by farmers. A grand total of over six hundred elevator-conveyors in five counties served by The Detroit Edison Company is proof of the acceptance of this labor-saving equipment for farm use, and we are proud to know that in the five counties mentioned the inexpensive elevator-conveyor has released over 1200 men to do other necessary farm work.

The portable elevator-conveyor is a proven piece of electrical farm equipment and its use will do much to alleviate the farm-labor shortage and enable the farmer to produce more food during the present emergency.

Automatic Feed Control for Feed Grinders

(Continued from page 326)

closing the shutoff the operator would have to remain near by for some time until the chute emptied itself of grain before he could stop the motor. When the controller was installed, the operator merely closed the shutoff in the chute when he had enough grain ground and went on with his other work. As soon as the chute and the hammer mill became empty the torque on the motor was reduced and the locking device acted to trip the motor switch automatically and stop the motor.

It is believed that the type of controller just described has possibilities of being widely used for controlling the rate of flow of material to feed grinders, hammer mills, etc. The additional cost of the complete hammer mill, equipped with a controller of this type, should not be excessive since all parts could easily be fabricated using welded construction. The size of motor with which the controller is used does not seem to be limited as experiments indicated that it operated equally as well with a 10-hp motor as it did with a ½-hp motor. Although the controller has not actually been used for grinding roughage, ear corn, etc., proper design of the valve and feed hopper should permit such materials to be fed to the mill with the same uniformity as small grains and shelled corn.

Hammer mills and feed grinders already in use may be easily converted to use this type of controller. As shown in Fig. 2 the only change made in the feed hopper of the hammer mill was to remove the adjusting screw from the feed gate and replace it with a rod attached to the lever of the controlling mechanism. No changes at all were required in the hopper or adjustable-feed gate of the hammer mill.

This method for controlling the load on an electric motor by mechanical rather than electrical means should find possibilities for use in the industrial field as well as for agricultural uses. For example, it might be used as a means to provide damper control for ventilating fans, regulate the rate of flow to rock crushers, control the rate of discharge from centrifugal pumps, or any other conditions where it is desired that a driven machine impose a condition of constant load on its driver.

Tractor Seats

TO THE EDITOR:

REFERRING to the editorial, entitled "Tractors Outwear Farmers" in AGRICULTURAL ENGINEERING for July, I should like to say that we have felt for years that the seat has been the least modernized of any part of the tractor.

The . . . . tractor seat appears to be vastly superior to anything else we have seen. It consists of a shock absorber similar to those on the rear of present-day cars plus a coil spring under a specially made seat. We have had one on a Farmall tractor since February, and everyone seems to like it very much.

A. J. BELL

Extension agricultural engineer
Michigan State College

* * *

TO THE EDITOR:

APROPOS of the editorial on tractor seats in your July issue, you will be interested in the following quotation from a letter we received recently:

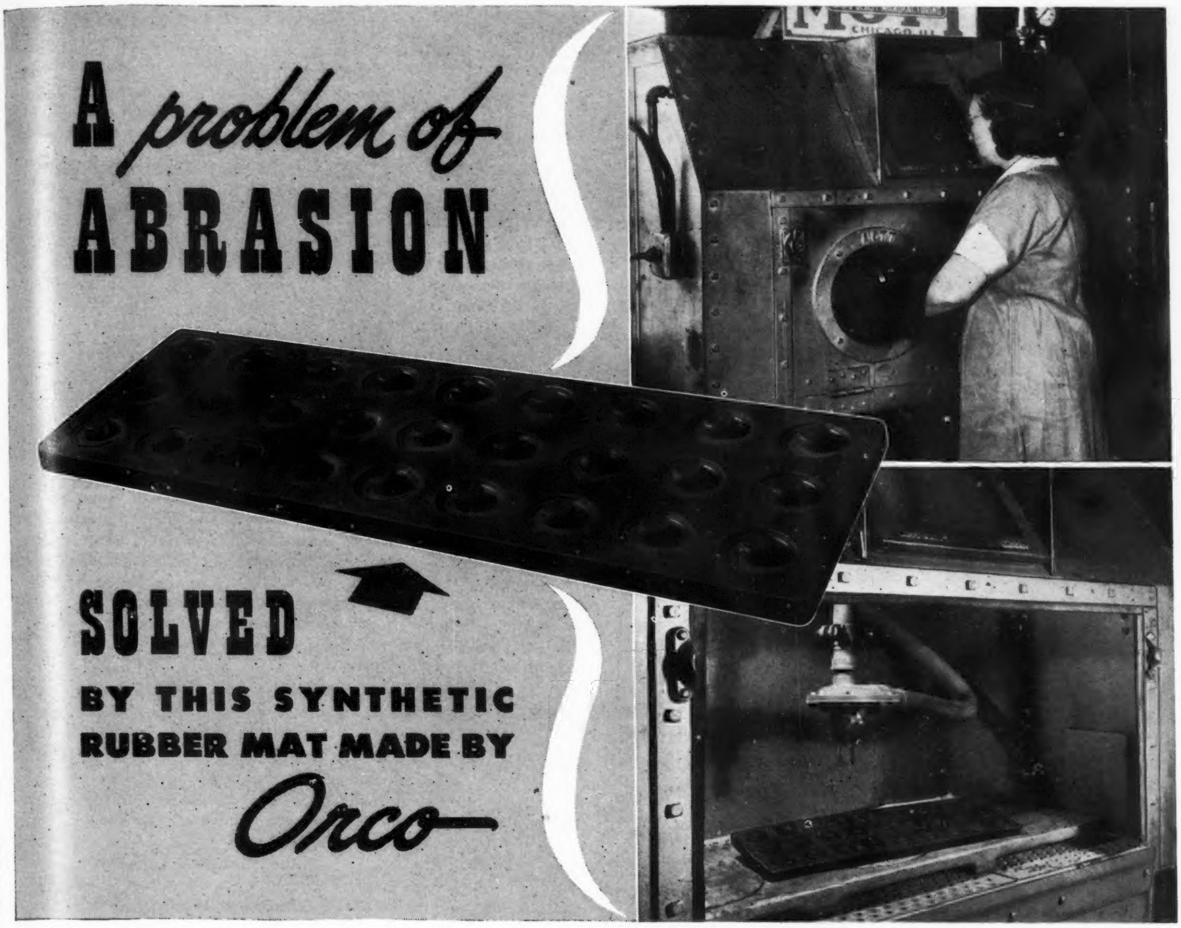
"The . . . . County Conservation District directors purchased a . . . . tractor with a terracing attachment a year ago. They have done very little work with it as they have been unable to keep an operator. They have had three to date and are starting their fourth one out this morning.

"Of course terracing work is very rough work but the three men stated they were unable to change positions as all the room they had was a place for the seat and just enough room to place each foot.

"'A five-foot man could slide back and forth on the seat, but a taller man had to sit rigidly all day."

E. E. BRACKETT

Head, Agricultural Engineering Department
University of Nebraska



MORGANITE BRUSH CO., INC., of Long Island, N.Y. installed the modern sand-blast equipment illustrated above. Function of this machine is to blast-clean large quantities of small seals uniformly.

To do this effectively and economically, the seals to be blast-cleaned are placed in the circular depressions moulded in the synthetic rubber mat illustrated.

Before this synthetic rubber mat was developed by ORCO engineers, experimental mats were made of various materials. All failed to stand up under the destructive abrasive action of the blast-cleaning operation.

After sand-blasting thousands of seals held in position by the ORCO-made synthetic rubber mat, Mr. L. Renhall, Production Supervisor of "MORGANITE" states that the mats "show no signs of wear."

In addition to its high resistance to abrasion, the ORCO synthetic rubber mats have the advantages of light weight (for ease in handling) and flexibility (for expediting removal of seals after blast-cleaning).

This is one of almost countless instances where ORCO rubber engineering is called upon to meet combinations of related specifications. When YOU face problems in rubber and synthetic rubber, call for "ORCO-OPERATION."

ORCO-OPERATION is a one word designation of complete cooperation in engineering and manufacturing mechanical molded and extruded rubber parts including rubber-to-metal adhesion processes . . . all available at The Ohio Rubber Company.

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Not So Crazy

TO THE EDITOR:

YOU might be interested in the adventures of a farmer-inventor. While using tractors for 26 years and trucks for 20 years, I have often wanted something better. Present tractors and trucks are the end results of 40 years' steady engineering improvement. Each does a good job in a narrow range of work. Together they have replaced half the 26,000,000 work animals on farms in 1918.

To me, the fact that farmers still keep 13,000,000 animals for power, while the horse has disappeared from the highway, is proof that neither tractor nor truck meets all farm-power requirements. So I went to work to analyze the farm job to find out how a tool could be built to displace another big fraction of those 13,000,000 horses and mules.

The result was a design I call the "trac-truk", a combination tool for both field work and intrafarm transportation. It is nothing more nor less than the principle of the old Moline "Universal" tractor without the mechanical faults which put the Moline out of business. I believe that the present track-type, standard four-wheel, and general-purpose tractors and the present trucks each fill farm power needs which do not need anything different. What I do see is that there are those 13,000,000 animals waiting for a new power unit that can do what they are now doing.

Last winter I went West at the request of one of the principal farmer cooperatives and of an automotive manufacturer, to study farm power manufacture in the reconversion of three war plants. The worst difficulty I found at two of them was the fact that the chief executive was a city millionaire farmer who thought he knew all there is to know about farming. Unfortunately I did not have the tact to appear to believe it.

When the 11,000,000 service men get home, they will be so familiar with tanks, half-tracks, jeeps and airplanes that they might be willing to use a farm power unit different from the present types. Those who return to the farm will hate worse than ever to go back to the horse for half their farm work. This is where I have a chance to sell my trac-truk design.

Sounds crazy, does it not, to think of a "dirt farmer" attempting to design a farm power unit, when all he knows about it is what he wants it to do?

DANIEL DEAN

Tioga County (N.Y.) farmer

Sell Surpluses Soundly

(Continued from page 315)

ness. It obviously will be detrimental to permit the selling of surpluses to weaken or destroy the service on which he relies.

Neither do we deem it desirable for public or quasi-public agencies engaged primarily in education to be distracted from their proper purposes in order to act for a time as distribution channels. Superficially some savings might be made by charging overhead to public or organization treasuries, but when repercussion on tax receipts is considered we suspect that any alleged saving would disappear.

Wisely guided, the inevitable losses on surplus property can be in part redeemed by stimulating the rebuilding and re-equipment which American agriculture so greatly needs. But farm improvement is so sensitively cued to satisfactory and stable farm income, and this in turn is so geared to the general economic activity, that the most helpful thing to do is to restore every aspect of business and employment quickly and smoothly, not to the equal of the war level, but to the normal peace basis.

NEWS SECTION

President Long on College Advisory Board

PRESIDENT J. DEWEY LONG of the American Society of Agricultural Engineers recently accepted an invitation extended him by President Wilson Compton of the State College of Washington, on behalf of the board of regents of that institution, to become a member of the newly formed 20-member "Technological Advisory Board" of the college.

Nominations for A.S.A.E. Medal Awards

IN ACCORD with the rules governing the award of the John Deere and Cyrus Hall McCormick gold medals, the Jury of Awards of the American Society of Agricultural Engineers will receive from members of the Society, up to November 1, nominations of candidates for these two awards for the next year.

Members of the Society nominating candidates for either award are requested to keep in mind the purposes of each medal and formulate their nominations accordingly. The John Deere medal is awarded for "distinguished achievement in the application of science and art to the soil," which citation is interpreted to cover more than a mechanistic concept of engineering, and to include chemistry, physics, biology, and any other science and art involving the soil, the "application" being acceptable to "evaluation by the engineering criteria of practicality and economic advantage."

The Cyrus Hall McCormick medal is awarded "for exceptional and meritorious achievements of a continuing career or to any single item of engineering achievement, and to apply equally to all special fields and types of engineering in agriculture."

The Jury of Awards desires that members of the Society consider it their duty and obligation to give serious thought to the matter and to nominate for these awards the men they believe to be most worthy of the honor. Each nomination must be accompanied by a statement of the reasons for nominating the candidate and the qualifications of the nominee, including his training, experience, contributions to the field for agriculture, a bibliography of his published writings, and any further information which might be useful to the Jury in its deliberations.

The Jury will accept and consider nominations received on or before November 1, and these nominations should be addressed directly to the Secretary of the Society at Saint Joseph, Michigan. The Secretary will supply on request a standard set of instructions for preparing information in support of nominees for the Society's gold medal awards; it is desirable that these instructions be followed in preparing material on behalf of any nominee.

A.S.A.E Meetings

THE Council of the American Society of Agricultural Engineers voted last month to hold the Society's 1946 annual meeting at the New Jefferson Hotel in St. Louis on June 24, 25, and 26. The Society cancelled its 1945 annual meeting in accord with the government ban on large gatherings, and Society members are looking forward in the hope that it may be possible to hold its annual meeting next year.

The 1944 fall meeting of the Society, which was to have been held in December, was cancelled at government request, and unless current travel conditions change greatly, it is not likely that the 1945 fall meeting, scheduled to be held at the Stevens Hotel, Chicago, December 17, 18, and 19, will be held.

Personals of A.S.A.E. Members

Earl L. Arnold is now serving as assistant chief, farm production supply staff, Office of Civilian Requirements, War Production Board. His new activity consists of looking after farmers' interests throughout WPB activities with particular emphasis on those production needs with which the Department of Agriculture does not concern itself.

(Continued on page 334)

Personals of A.S.A.E. Members

(Continued from page 332)

John F. Benham is now educational director of the American Seed Trade Association and is located at 30 North LaSalle Street, Chicago. He was previously agricultural agent for the Pennsylvania Railroad. In his new work he will be engaged in the organization and direction of a program of education, research and public relations for the seed industry.

Ralph U. Blasingame, head, agricultural engineering department, Pennsylvania State College, is on leave of absence to supervise courses in agricultural engineering being offered at Army University Center No. 1 that has been set up at Shrivenham, England, to instruct young men in the American armed forces while they are waiting to be sent home or elsewhere.

L. O. Drew recently obtained his master's degree in agricultural engineering from Iowa State College and has accepted the position of assistant agricultural engineer at the South Carolina Agricultural Experiment Station. He will be connected with the Edisto substation at Blackville.

Orval C. French, after a leave of absence of nearly three years in which he has been serving on the mechanical engineering staff at the radiation laboratory of the University of California at Berkeley, has now returned to his former duties as a member of the division of agricultural engineering of the University at Davis.

Louis M. Glymph, Jr., who has been serving as soil conservationist (engineer) of the U. S. Soil Conservation in Pennsylvania, has been transferred to the sedimentation section of SCS and assigned to the Sacramento District Office of the U. S. Engineers to conduct sedimentation investigations relative to reservoirs authorized for construction by the Army engineers in the Sacramento and San Joaquin River drainage basins.

Rene Guillou, who has been serving as chief engineer, water division, transportation corps, U. S. Army Transport, has recently been released to engage in some engineering research on war projects at the University of California in Los Angeles.

L. J. Smith, head, agricultural engineering department, State College of Washington, is one of the authors of Bulletin No. 461, recently issued by the Washington Agricultural Experiment Station, entitled "Approved Milking Parlors for the State of Washington".

Lawrence R. Swarner, who has been serving as assistant irrigation engineer for the USDA Bureau of Plant Industry, Soils and Agricultural Engineering at Bedford, Oregon, recently accepted a position as engineer with the Bureau of Reclamation of the U. S. Department of the Interior. He is located at the regional office of the Bureau at Boise, Idaho and will have charge of all soil and irrigation investigations in Washington, Oregon and Idaho.

David S. Weaver, head, agricultural engineering department, University of North Carolina, is one of the authors of Extension Circular No. 282, entitled "Frozen Food Locker Plants", recently issued by the North Carolina Agricultural Extension Service.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Donald E. Bertholf, Lt. (jg), USNR. (Mail) USNR Midshipmen School, University of Notre Dame, Notre Dame, Ind.

Garnett Y. Carpenter, Jr., Capt., USA. (Mail) Box 656, Waynesboro, Pa.

Edward W. Foss, extension agricultural engineer, University of Maine, Orono, Me.

Bernard A. Gehl, product engineer, in charge of corn pickers, Wood Bros. Thresher Co., Des Moines, Iowa. (Mail) 115 42nd St.

D. B. Mabry, sales, T. J. Moss Tie Co., 700 Security Bldg., St. Louis, Mo.

Harold N. Simpson, general manager, Harold N. Simpson Company, 818 Harrison St., Oak Park, Ill.

B. E. Sivyer, sales manager, chain belt and transmission division, Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.

TRANSFER OF GRADE

R. A. Schmidt, farm service engineer, Imperial Oil, Ltd., Regina, Sask., Canada. (Junior Member to Member)

John Strait, instruction and research in agricultural engineering, University of Minnesota, University Farm, St. Paul 8, Minn. (Junior Member to Member)

New Literature

"PRINCIPLES OF BRICK ENGINEERING," by Harry C. Plummer, director of engineering and research, Structural Clay Products Institute, and Leslie J. Reardon, assistant professor of applied mechanics, Case School of Applied Science. Cloth, 6x9 inches, 437 pages, 54 figures. Structural Clay Products Institute, Washington, D. C. Price $4.50.

This book is chiefly a handbook of design, and is an attempt to correlate the extensive research that has been conducted during the past two decades on plain and reinforced brick masonry, and to include in one volume the best available information on the subject. The book is divided into fourteen chapters, under the following headings: Brick; mortar; brick masonry; footings, foundations, piers and columns; walls and partitions; chimneys, fireplaces and stacks; floors, walks and garden structures; moisture control; reinforced brick masonry; beams, lintels and slabs; R-B-M columns and piers; footings, foundations and retaining walls; brick sewers, and miscellaneous structures of reinforced brick masonry. The book also contains a four-part appendix of 70 pages containing estimating tables, standard specifications, bibliography, and a glossary of terms.

"S.A.E. HANDBOOK" (1945 Edition). The Society of Automotive Engineers, Inc., 29 West 29th Street, New York 18, N. Y. Price to non-members of S.A.E., $5.00 per copy.

This latest edition of the well-known automotive engineers' handbook presents new S.A.E. standards on electrical equipment and non-metallic materials, and revised S.A.E. standards on gasoline engines, iron and steel, lighting, non-ferrous metals, and parts and fittings. The new standards cover starting motor and generator curves, generator and starter mountings, starter pinion and ring gears, and windshield wiper hose. Revised standards include methods of determining steel hardenability, steel hardness, conversion numbers, automotive gray iron castings, NE steels, automobile wiring, insulated cable, and license plate lamps. The 620 pages of text contain all S.A.E. official current standards and recommended practices, except those which are aeronautical, plus general data having important bearing upon both standards and recommended practices. This new volume supersedes all earlier editions.

"BARN HAY DRIER - Principles of Design, Installation and Operation," by John A. Schaller, Nolan Mitchell, and W. H. Dickerson, Jr., agricultural engineers, Tennessee Valley Authority. Agricultural Engineering Publication No. 6, of the Agricultural Engineering Development Division, Tennessee Valley Authority, Knoxville; 8½ x 11 inches, 129 pages 98 figures, $1.00 per copy.

This publication is based on results of the coordinated agricultural engineering research and educational program of the Tennessee Valley Authority with the land-grant colleges in the states in which the TVA operates. The material has been prepared by the authors in cooperation not only with technical staffs of land-grant institutions of the Tennessee Valley region but also with other institutions and organizations in the country that have conducted research and field work on the barn curing of hay. The publication supercedes the preliminary edition issued April, 1944. The book has been prepared for use by agricultural technicians and company representatives who are called upon to assist farmers in designing hay-drier systems. Although specially prepared for the southeast states, it also has application elsewhere. The publication is divided into five parts, in which Part I is an introduction, Part II deals with design and selection of equipment and materials, etc., Part III covers installation of the system as a whole including the equipment used with it, Part IV is devoted to the operation and management of the system, and Part V to supplemental heat. The publication also includes a carefully selected list of references on hay drying and an appendix containing material pertinent to the general subject.

"FARM BUILDING SERVICE," a 36-page publication issued by the Weyerhaeuser Sales Company, St. Paul, Minn. Sent on request.

This publication is a catalog of the Weyerhaeuser 4-Square Farm Building Service, and in it are described many new buildings and equipment items. Special consideration has been given to portable buildings suitable for fabrication by lumber dealers. The buildings listed in this catalog were planned for practical use and the selection of materials and method of putting them together were worked out by Weyerhaeuser engineers so that by following the plans, sound construction, long life and durability are assured. The buildings and equipment listed in this catalog cover poultry buildings and equipment, barns and barn equipment, hog buildings and equipment, cotton storage buildings, and machinery shelters. garages, shops, milk houses, etc.

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EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any Notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS OPEN

AGRICULTURAL ENGINEERS are wanted in the agricultural engineering divisions of the Bureau of Plant Industry, Soil, and Agricultural Engineering, U. S. Department of Agriculture. Several positions, from technicians to senior agricultural engineers, are open. Applicants should write, giving full particulars, to Arthur W. Turner, assistant chief of Bureau, North Laboratory, Agricultural Research Center, Beltsville, Md.

AGRICULTURAL ENGINEER is wanted for a teaching and research position in rural electrification, a discharge veteran with master's degree and family preferred. Give qualifications by letter to M. A. Sharp, Agricultural engineering department, University of Tennessee, Knoxville.

AGRICULTURAL ENGINEER, who is a good draftsman and has had experience in designing and constructing farm buildings and equipment, is wanted to do extension work. Salary depends upon qualifications and experience. Write giving full details of education and experience, draft status, and other particulars. Agricultural Engineering Department, University of Kentucky, Lexington, Ky.

ENGINEER wanted for surveying and design work connected with drainage, water control and conservation work. Permanent employment. Writing giving full details. PO-192

DESIGN ENGINEERS wanted by old-established farm implement company. Three product design engineers and three layout draftsmen are needed for tractors and farm implements. Men who can qualify for these positions will have unlimited opportunity. Positions are permanent for men who can qualify. Salary is open and depends on ability. PO-191

IRRIGATION ENGINEER wanted to take charge of experimental work on the irrigation station of a land-grant college in a north central state. Salary about $3400. Write giving full details of education and experience. PO-190

MECHANICAL ENGINEERS wanted for the mechanical development and designing of corn pickers, combines, other implements, and tractors. Permanent position with old, well-established Wisconsin manufacturer with world-wide distribution. Postwar markets assure big future in farm equipment. All inquiries will be acknowledged. PO-189

AGRICULTURAL ENGINEER wanted by national organization to act as field representative in farm building field in Michigan. Sales promotion and service work with no sales. Straight salary. Position will entail travel with expenses paid. PO-188

AGRICULTURAL ENGINEER, preferably with some sales experience in the building materials or construction field, or some extension experience in farm structures, wanted by a nationally known manufacturer of building materials to do educational, research and promotional work in the Middle West with headquarters in Chicago. Excellent opportunity for permanent postwar connection with a well-established, substantial manufacturing organization. Salary open. State education, experience, draft or service status in first letter. PO-187

AGRICULTURAL ENGINEER wanted to fill position as full-time assistant professor in well-organized eastern college extension service, with principal work in structures and farm safety. A man who can quickly sketch remodeling plans and organize county work is desired. PO-186

ASSOCIATE AGRICULTURAL ENGINEER wanted by New Mexico College of Agriculture and Mechanic Arts for research and teaching relative to irrigation, farm structures, and electricity. Salary depends on qualifications and experience. Write direct to Agricultural Experiment Station, State College, New Mexico.

RANCH MANGER wanted. Dried fruit and general farming on a California farm which is 100 per cent mechanized, 100 per cent irrigated by pipe lines, 100 per cent developed. This is a manu-

(Continued on page 342)

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EMPLOYMENT BULLETIN

(Continued from page 340)

facturing proposition requiring the skill of a thoroughgoing agricultural engineer experienced in western ways of farming. Living conditions, soil type, water conditions, proximity to the city - all of the best. Schools and colleges not far distant. Applicants will please give full statement, including age, education, health, family details, religious convictions, experience in detail, and other information in detail, also a photograph, in the first letter. PO-185

AGRICULTURAL ENGINEERS wanted for temporary and permanent positions in Latin America. Knowledge of Spanish desirable but not mandatory. Experience in the fields of soil conservation, drainage and irrigation. Salary and expense allowances. Write in detail, stating age, experience and when available. Address reply to Box 435, Ben Franklin Station, Washington, D. C.

AGRICULTURAL ENGINEER wanted by large muck land operator to improve and develop farm machinery for large operations. Good salary, permanent setup for a capable man. PO-183

AGRICULTURAL SALES ENGINEER wanted. Applicants will please state age, educational background, practical experience, and send photograph. Also state earnings expected and whether or not presently employed and with whom. A good job for the right party with opportunity for advancement with a fast-growing organization. PO-182

ASSISTANT AGRICULTURAL ENGINEER wanted for research in farm structures, equipment, and utilities. Equal division between college of agriculture and agricultural experiment station, including cooperative projects with industry and public utilities. Salary depends upon qualifications and experience. Give full particulars, including military status with application. University of Idaho. PO-181

ASSISTANT AGRICULTURAL ENGINEER wanted for research in hydraulics, irrigation, soil and water conservation. Equal division between college of agriculture and the agricultural experiment station, including cooperative projects with Soil Conservation Service. Salary depends upon qualifications and experience. Give full particulars including military status with applications. University of Idaho. PO-180

DRAFTSMAN wanted for development and design work on tractor and garden ground-working tools. A good opportunity for a man who can apply himself in this branch of agricultural tool development and designing. Location, Chicago, Ill. PO-179

ASSISTANT EXTENSION AGRICULTURAL ENGINEER wanted by Arkansas Agricultural Extension Service. The phases of work to be handled and the salary will depend primarily upon the training and experience of the applicant. Give brief explanation of training and experience in first letter. Write direct to L. A. Dhonau, State Agent, 524 Post Office Building, Little Rock, Ark.

AGRICULTURAL ENGINEERS, preferably men with some experience in farm equipment, are wanted by a nationally known manufacturer. Experience desired includes design, engineering applications, market research and merchandising. Excellent opportunity for men possessing either limited or broad experience. Salary open. Replies received on a confidential basis. Education, experience and special qualifications should be stated fairly complete in the first letter. PO-178

ENGINEERS AND DRAFTSMEN wanted by well-known manufacturer of farm and garden implements, to develop and design new tools, garden tractors and equipment. Positions permanent. PO-177

AGRICULTURAL ENGINEER wanted. Practical man with sales experience to join large steel company entering farm building field. Dealer sales development program needs men between 28 and 42 with agricultural engineering background and proven sales record in farm equipment, building or similar fields. Excellent opportunity to get in on ground floor of promising postwar industry. Salary. In reply, give complete history of education and business experience as well as references and a small photo. All replies will be held confidential. PO-176

AGRICULTURAL ENGINEER wanted by the Allahabad Agricultural Institute, Allahabad, India, for teaching position. Minimum qualifications, degree in agricultural engineering and some farm experience. Postgraduate degree desirable. Duties would be primarily teaching, but some opportunity to participate in research and extension. Candidate must be active Christian interested in

(Continued to page 344)

PROFESSIONAL DIRECTORY

GEORGE R. SHIER, A. E.
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Also Sales Engineering for Selected Manufacturers
Member A.S.A.E. Associated with Howard S. Sterner Company, Consulting Structural Engineers, 30 East Broad Street, Columbus, Ohio

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Agricultural Engineers
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FELLOW A.S.A.E. Suite 4300, Board of Trade Bldg.
MEMBER S.A.E. Telephone: Harrison 0723 Chicago 4, Illinois

RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of $1.00 per line per issue; 50 cents per line to A.S.A.E. members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

EMPLOYMENT BULLETIN

(Continued from page 342)

mission work. Discharged veteran with slight handicap eligible, if in good health otherwise. Applicants may correspond with Allahabad Agricultural Institute, 156 Fifth Ave., New York 10, N. Y.

RESEARCH ENGINEER wanted for work in farm structures and rural electrification in a land-grant college in a north central state. A young man is preferred. Salary $3000 or more depending upon qualifications. Write giving full details of education, experience, draft status, and other particulars. PO-174

POSITIONS WANTED

AGRICULTURAL EQUIPMENT BLOCKMAN available. Agricultural engineering graduate Kansas State College; 13 years' sales, collection and service experience with large farm machinery manufacturer; 2 years' teaching farm tractors at war training school; 1½ years' as industrial specialist in farm machinery division of WPB in Washington, and 2 years' war factory production. Desires high-type sales position in Southwest. Age 41, excellent health, married, rural background, superior salesman-executive, good organizer and a consistent producer. Best references. PW-373

AGRICULTURAL ENGINEER desires employment with either farm machinery or farm buildings construction company; is principally interested in functional design of farm machinery or buildings. Graduate in agricultural engineering from Iowa State College in 1933. Has had 12 years' experience in agricultural engineering work including soil conservation, land surveys, and farm building construction. Is presently managing a large number of farms in Minnesota where tenants are part owners of livestock. Prefers north central states. Age, 35. Married, 3 children. Can give excellent references and employment record. PW-372

AGRICULTURAL ENGINEER, graduate of a midwest state college, desires employment in California. Has several years of design experience with large farm machinery manufacturers as well as general production experience. PW-371

AGRICULTURAL ENGINEER, graduate of Cornell University, with 5 years' experience in college teaching, research and extension; 1 year in research and advertising; 12 years in retail building material sales and service; 3 years scheduling and expediting for WFA, desires position with firm having production, sales or service problems in New York, Pennsylvania, Maryland, or Virginia. PW-370

RESEARCH ENGINEER available. Research course work begun in December, 1943, at Iowa State College towards a Ph. D. degree. Other academic and professional education was at State College of Washington, 1933. B.S.; 1934, M.S.; 1939, Ag. E. Also a registered professional engineer. Seventeen years of education and experience, since entering college in September, 1923 (self-liquidating). Experience in the federal government, land-grant institutions, and private power systems. Born and reared on a farm. Temporarily employed as an assistant extension agricultural engineer. Thirty-five years of age, married, two children. Available at salary range of $4000 to $8000 per year. PW-365

AGRICULTURAL ENGINEERING

Established 1920

CONTENTS FOR SEPTEMBER, 1945

Vol. 26, No. 9

This Journal is owned, edited, and published monthly by the American Society of Agricultural Engineers.

Editorial and advertising departments at the executive office of the Society, Saint Joseph, Michigan. Publication office at Benton Harbor, Michigan.

SUBSCRIPTION PRICE: $3.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to A.S.A.E. members anywhere, $2.00 a year. Single copies (current), 30 cents each.

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Home-Made Plywood Poultry Brooders

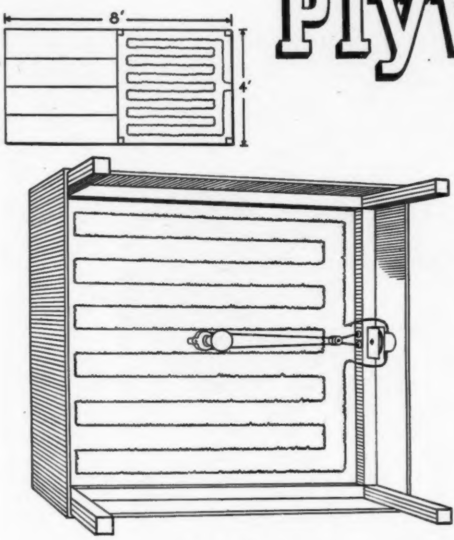


Figure 1
A simple 4 foot square frame of 1 x 4 foot strips of ¼" plywood set 4 inches above the floor on 2 x 2 inch legs is the basis of several brooder designs. In the design shown above the plywood top is supported on 1 x 2 inch mailing strips 4 inches below the tops of the side panels. Easily-replaceable loose-fill insulation (floor litter) is used in this 4 inch top space. The electrical wiring consists of an attraction light, a thermostat and 125 feet of coiled No. 22 gauge tinned iron wire. The wire heating coil is tacked to the underside of the plywood top but does not become hot enough to discolor the wood. Commercial strip heaters may also be used.

Plywood is the ideal material for building home-made hovers.

Plywood panels are easily fabricated by home mechanics, and hovers of the type illustrated are light weight, withstand hard usage and have excellent operating characteristics. It is essential, of course, that the heating elements and wiring follow closely the recommendations given in college bulletins for each type.

Some of the war-time expedients in heating elements are giving excellent service and will be popular with farmers post-war. Many of the poultry equipment manufacturers list easily installed kits of heating elements and wire. The radiant heat and forced-air type installations are interesting new developments in brooder design.

Plywood hovers may be readily constructed in various sizes from 50 chick capacity (2 x 2 feet) to 500 chick size (4 x 8 feet). They may also be designed as removable brooding compartments in backyard or farm brooder houses of plywood construction. The larger sizes and the compartment types may have a portion of the top hinged for ready access to the chicks or turkey poults.

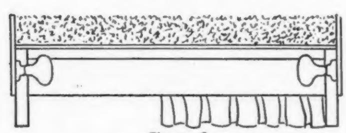


Figure 2
Electric heat lamps selected for wattage according to prevailing air temperatures by watching the behavior of the chicks provide a simple heating installation. The wire coil, strip heater and heat lamp installations operate on the radiant heat principle.

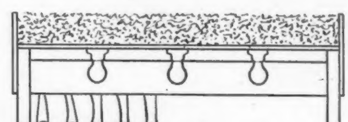


Figure 3
Ordinary Mazda electric light globes may be fastened to the underside of the plywood top. They may be controlled by a thermostat, or by unscrewing one or more globes on warm days. Slit curtains below the plywood sides are required on all connection heat brooders.

TYPICAL REFERENCES

UNIV. OF ARIZONA
Ext. Bul. W-17. Electric Chick Brooder.

UNIV. OF IDAHO
Plan 7271-32. Radiant Heat Electric Brooder.

PURDUE UNIV.
Leaflet 240. Electric Chick Brooder.

MISSISSIPPI STATE COLLEGE
Plan 7271-11. Fifty Chick Electric Heated Brooder.

CORNELL UNIV.
Ext. Bul. 552. Home-Built Electric Brooders.

OHIO STATE UNIV.
Bul. 238. Home Made Electric Lamp Brooder.

OREGON STATE COLLEGE
Sta. Cir. 146. Homemade Electric Brooders.

CLEMSON AGR. COLLEGE
Mimeo. Plan. Chick Brooder.

TEXAS A & M COLLEGE
Cir. 195. Homemade Electric Brooders.

WASHINGTON STATE COLLEGE
Pop. Bul. 169. Wartime Iron Wire Poultry Brooders.

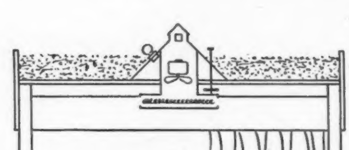


Figure 4
Commercial forced-air heating units may be set into the plywood top. As the chicks grow the legs of the hover are set on bricks to give additional head room.

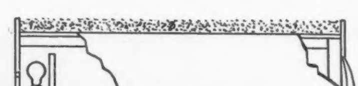
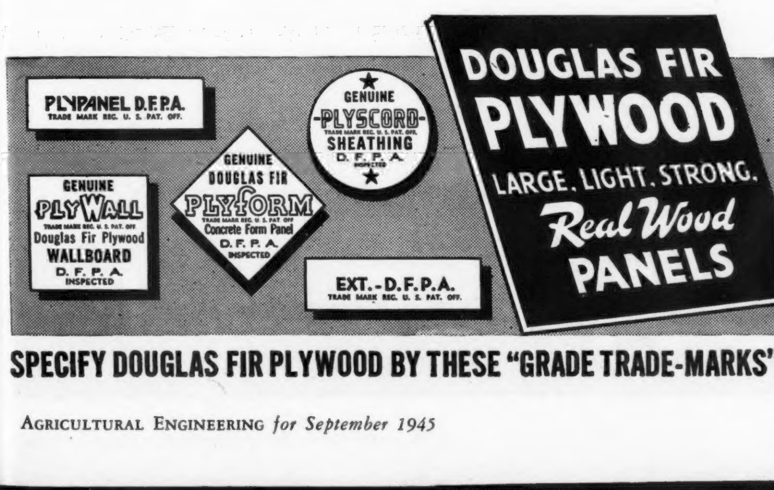
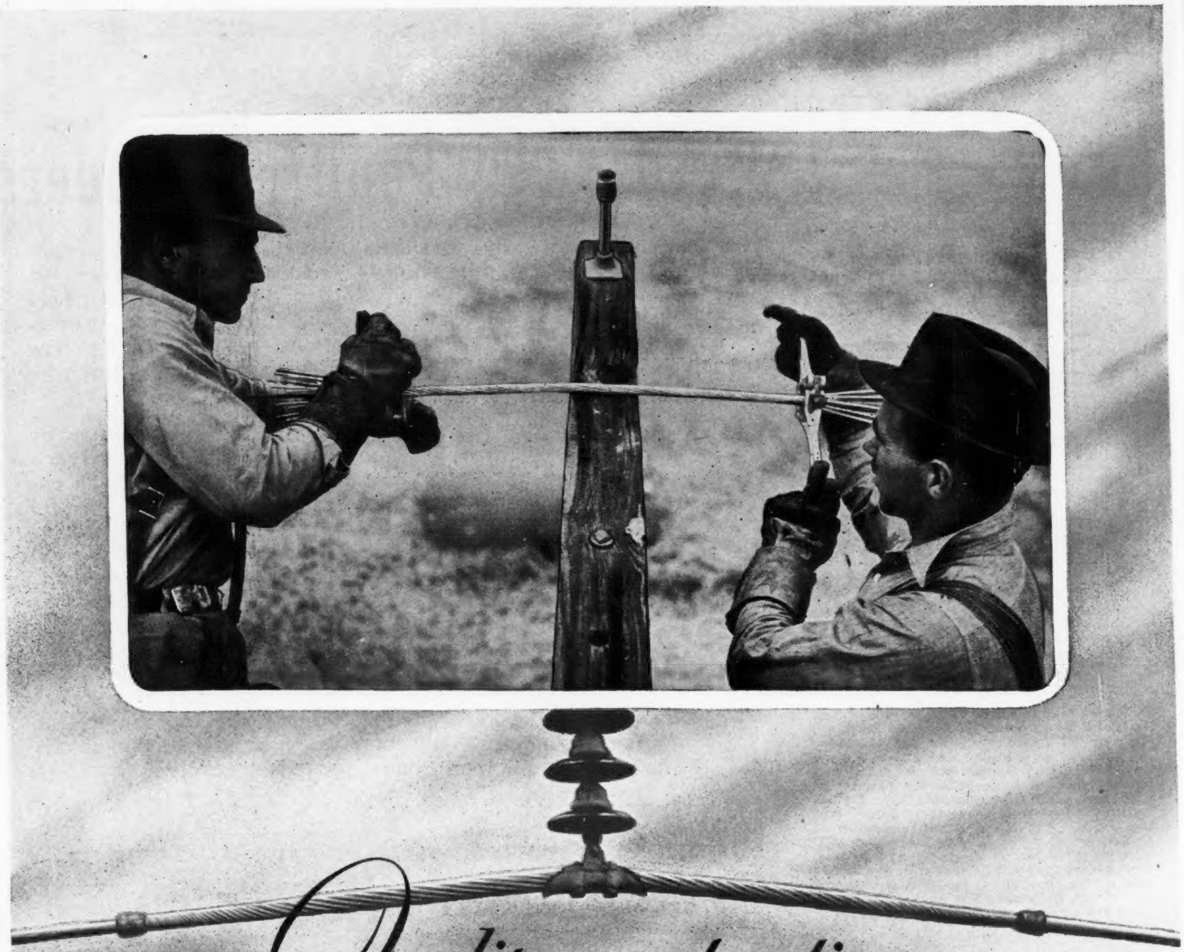


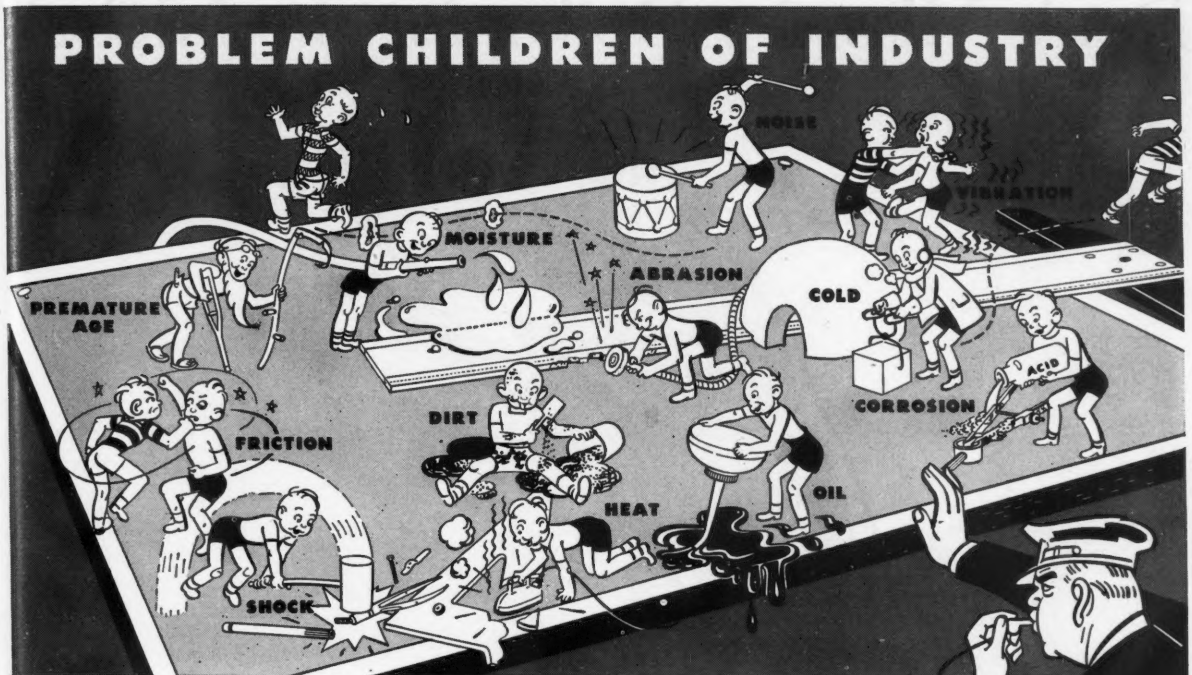
Figure 5
The box may be set on the floor with an opening along one side. Mazda lamps in a protecting trough or commercial heating elements with a baffle are placed at the back. Air inlet holes are bored through the rear wall.



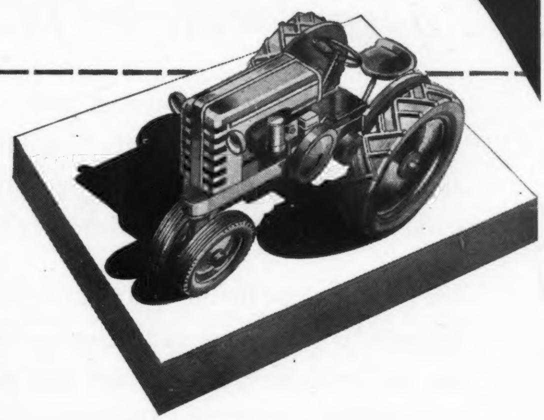
Farm Buildings are War Equipment
. . . Keep Them Fit and Fighting

SPECIFY DOUGLAS FIR PLYWOOD BY THESE "GRADE TRADE-MARKS"





Keep them away from *Your* Postwar PRODUCTS



● Greater control of vibration, shock, friction, abrasion, and many other "problem children of industry" is now possible due to improved methods of compounding, molding, extruding, calendering, coating, and bonding natural and synthetic rubbers.

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Plowing, planting, cultivating, harvesting—these are big items in modern land management. It is difficult to make these operations pay when poor drainage, stumps or boulders hinder machine efficiency. The controlled force of explosives can help.

On the farm, as in the quarry, in the mine, or on construction projects, it's the final result that counts. Explosives are a working tool to make the job easier and to lower costs and to meet present food shortages. Today, explosives are particularly important in helping Drainage and Conservation Districts to get rid of flood or excess waters.

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One of the great dramatic moments in railroading occurred when the Cotton Belt changed the gauge of its 419 miles of track in a single week end. The scene pictured above is our artist's conception of the closing hours of this successful old-time race against time.

CHANGING THE MEASURE OF RAILROADING

It was September in 1886. All along the Cotton Belt, from Bird's Point, Mo., to Texarkana, old spikes came out. Rails were shifted. New spikes sank home under swinging hammers. The entire railroad was changed from narrow to standard gauge over one week end. The Cotton Belt had stepped along with the times.

This railroad is still stepping along. It is one of 83 railroads and major industries where General Motors Diesel locomotives are changing the measure of railroading.

Watch what happens when complete lines and systems are GM Dieselized. Far faster freight hauls. Quicker, more comfortable, and more reliable travel for passengers.

And reduced maintenance by sturdiness that goes a million miles or more without major overhaul!

Yes, the measure of railroading is changing—for the better. And GM Diesel locomotives are helping to bring about this new benefit for the railroads, for the country, and for you.

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BUY MORE BONDS

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ENGINES......150 to 2000 H.P.....CLEVELAND DIESEL ENGINE DIVISION, Cleveland 11, Ohio


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EDITORIAL

Our 25th Anniversary

IT WAS in September, 1920, that the initial number of AGRICULTURAL ENGINEERING was published. It was not a propitious time for launching a new publication, nor for any venture connected with agriculture. It was in the later part of 1920 that postwar inflation reached its first break, consisting mainly of an agricultural collapse. In the months to follow, many well-established farm and allied trade papers "folded up" and many more required retrenchment and reorganization. In the years to follow, the number of tractor manufacturers dwindled from more than a hundred to about a dozen.

Besides that ominous situation, there was an alleged ill omen; the American Society of Agricultural Engineers was then thirteen years old. Far from foreboding, its members chafed under the lack of an adequate medium in which to record and to read its rapidly expanding technology. Regardless of publishing prospects, they were determined to have their own professional journal.

It was an uphill struggle at first, without experienced editorial talent, without advertising sales representation, without the momentum whereby similar publications managed to get through that troubled time; that is, those that did get through. After the first few issues AGRICULTURAL ENGINEERING was taken temporarily under the wing of The Power Farming Press at St. Joseph, Michigan, despite the fact that this established firm was at a crisis in its own affairs. For that friendly help we must ever be grateful to the firm's president, the late Elliott C. Davidson.

Even that expert assistance probably would not have sufficed, had it not been for the loyalty and the vision of our early advertisers. They looked beyond current balance sheets to the time when bread cast upon the waters should come back. They saw the time when the work of the agricultural engineer should create great new markets, and when he himself should wield wide influence in the choice of equipment and materials within those markets. Similar loyalty during the later and longer depression mitigated the trials of that period. Throughout has been the recognition by our readers, especially the older members of the Society who had shared in the qualms of its founding, that the size, and even the survival, of their professional journal was in large part due to its acceptance as an advertising medium.

Perhaps it should be mentioned that throughout the quarter-century the prime p u r p o s e of AGRICULTURAL ENGINEERING has been to serve the profession, not to seek popular appeal. Its modest success in the commercial sense has been and will continue to be secondary to its accuracy and authenticity as a record of technical progress. Based both on the experience of the first 25 years and the bright future which faces the profession we look with confidence toward the years ahead.

"Fluxability" in Buildings

FOR SEVERAL reasons we feel considerable enthusiasm over the paper by Curry and Giese appearing as the leading article in these pages. First is the large degree of recognition which they give to the human equation in farming practice, the largely ignored fact that successive operators of a farm may have sharply diverse talents and tastes. We call to mind a farm whereon the owner put up a well-appointed milkhouse for a tenant who catered to the fluid milk market. After only a few years, in the hands of another tenant, that building serves as a makeshift farm shop.

Implied in the article, but deserving of more explicit emphasis, is the fact that we cannot foresee the changes in farming practice which will unfold during the life of a farm building. We do know that such changes will occur at an increasingly rapid rate. Mechanization and electrification have only begun their impact on farm service buildings, even though firmly established in field and dwelling respectively. We face a period of flux, and for it farm structures should embody "fluxability".

Also we feel more optimistic than the authors about the opportunities for prefabricated buildings and building units. We foresee not only the economies of mass manufacture by concentrating on a few basic designs and standard dimensions. We see also a field for originality and specialization in building elements and equipment wherein the inventor and small manufacturer can create a design that will fit into anybody's barn or granary.

By diverting more of building manufacture into the factory, the resulting efficiency will go far to offset the increasing costs of labor which otherwise are likely to be a barrier. There should also be a substantial sales advantage, from the fact that farmers have less hesitancy about buying a completed product than they do about beginning with a blueprint. The sooner we can sell buildings instead of suggesting plans, the sooner will come the renaissance in farm structures.

Invention Goes Underground

ONE of the members of the American Society of Agricultural Engineers, himself an inventor in a small way, has concerned himself for many years with the history and philosophy of invention, particularly in America and in the realm of agriculture. One of his observations is that the more significant inventions in farm machinery have come not from industry or research but from farmers themselves. He regards fecundity of invention, measured by the number of patents issued, as an index to the rate of national progress. He has been greatly disturbed by the dearth of invention in and since the decade that started with 1930.

In a discussion more detailed than can be cited here, the "Industrial Bulletin" of Arthur D. Little, Inc., attempts to appraise the causes for a drop of 41.5 per cent in patents issued from 1933 to 1943. After estimating the decline due to war causes, as well as those of depression, it comes to the conclusion that:

"The major factor . . . . . is more fundamental in that it is not likely to be relieved by the cessation of war. This factor is the increased severity of the government and the courts in their attitude towards patents . . . . As a result the inventor and the manufacturer tend to place less reliance on patent protection and more on secrecy."

It could easily be argued that secret technology is not in the best national interest. It would seem to be raw material for cartels of the sinister sort. It could be an obstacle rather than an asset in time of national emergency. What we choose to emphasize, however, is its impact on the independent inventor, notably the farm inventor as mentioned above. He is not constituted nor connected to sell secrets to big business. With the forces of law and national policy whittling away patent protection, it will dry up this free-lance source of fruitful invention.

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